

**Risks of Captan Use to Federally Threatened
California Red-legged Frog**
(Rana aurora draytonii)

Pesticide Effects Determination

**Environmental Fate and Effects Division
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1. Executive Summary

The purpose of this assessment is to evaluate potential direct and indirect effects on the California red-legged frog (*Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding use of captan on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in the modification of the species' designated critical habitat. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998 and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004).

The CRLF was listed as a threatened species by USFWS in 1996. The species is endemic to California and Baja California (Mexico) and inhabits both coastal and interior mountain ranges. A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS, 1996) in California.

Captan is a registered non-systemic fungicide used to control diseases for several agricultural crops including orchard and vineyard crops, berries, ginseng, and seeds. In addition it is also used for non-agricultural crops including turf, ornamental grasses, and flowers. Residential turf uses have been voluntarily cancelled and are not included in this assessment. Captan is registered for several formulations and is applied by various methods, including aerial, airblast, and ground applications.

Usage data suggests that areas with the largest captan usage in California, such as Monterey County, overlap with counties having the greatest numbers of the CRLF. According to the California Department of Pesticide Regulation's Pesticide Use Reporting database, the largest captan usage in California is strawberries in Ventura County averaging 102,351 pounds annually for the years 2002 to 2005. The next highest captan usage is strawberries in Monterey, Orange, and Santa Barbara Counties. Strawberries, almonds, prunes, grapes, non-outdoor transplants, and peaches account for over 98% of captan use in California for the years 2002 to 2005.

Since CRLFs exist within aquatic and terrestrial habitats, exposure of the CRLF, its prey and its habitats to captan are assessed separately for the two habitats. Aquatic exposure models estimated high-end exposures of captan in aquatic habitats resulting from runoff and spray drift from different uses. Peak model-estimated environmental concentrations resulting from different captan uses range from 21.6 µg/L for the food uses to 28.6 µg/L for the ornamental uses. California Department of Pesticide Regulation (CDPR) found no detectable levels of captan at 4 sites in Santa Cruz County and 3 sites in neighboring Monterey County on December 13, 1994; however samples were only collected on one day and therefore conclusions cannot be drawn from these results. At the present time, neither captan nor its degradates are included in the USGS-NAWQA program. AgDRIFT and AGDISP models are used to estimate deposition of captan from local spray drift on terrestrial habitats that neighbor application sites. Captan has low potential for volatility

and air monitoring samples were below the level of detection, therefore long range transport is unlikely.

Captan degrades rapidly and forms two major degradation products tetrahydrophthalimide (THPI) and trichloromethylthio (TCMT). THPI is more persistent than the parent. THPI is also degraded into a series of ring products, including tetrahydrophthalimic acid (THPAm). Aquatic toxicity data for THPI and THPAm are available and indicates that the degradates are about four orders of magnitude less toxic than the parent. Tier I GENEEC screening model was used to estimate EECs and the potential for level of concern (LOC) exceedances for aquatic organisms. Since no exceedance was observed, THPI is not considered in this assessment.

The assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF itself, as well as indirect effects, such as reduction of the prey base and/or modification of its habitat. Direct effects to the CRLF in the aquatic habitat are based on toxicity information for freshwater fish, which are generally used as a surrogate for aquatic-phase amphibians. In the terrestrial habitat, direct effects are based on toxicity information for birds, which are used as a surrogate for terrestrial-phase amphibians. Given that the CRLF's prey items and designated critical habitat requirements in the aquatic habitat are dependant on the availability of freshwater aquatic invertebrates and aquatic plants, toxicity information for these taxonomic groups is also discussed. In the terrestrial habitat, indirect effects due to depletion of prey are assessed by considering effects to terrestrial insects, small terrestrial mammals, and frogs. Indirect effects due to modification of the terrestrial habitat are characterized by available data for terrestrial monocots and dicots.

Risk quotients (RQs) are derived as quantitative estimates of potential high-end risk. Acute and chronic RQs are compared to the Agency's levels of concern (LOCs) to identify instances where captan use within the action area has the potential to adversely affect the CRLF and its designated critical habitat via direct toxicity or indirectly based on direct effects to its food supply (i.e., freshwater invertebrates, algae, fish, frogs, terrestrial invertebrates, and mammals) or habitat (i.e., aquatic plants and terrestrial upland and riparian vegetation). When RQs for a particular type of effect are below LOCs, the pesticide is determined to have "no effect" on the subject species. Where RQs exceed LOCs, a potential to cause adverse effects is identified, leading to a conclusion of "may affect." If a determination is made that use of captan within the action area "may affect" the CRLF and its designated critical habitat, additional information is considered to refine the potential for exposure and effects, and the best available information is used to distinguish those actions that "may affect, but not likely to adversely affect" (NLAA) from those actions that are "likely to adversely affect" (LAA) the CRLF and its critical habitat.

For the aquatic-phase CRLF, an LAA determination was concluded for direct effects based on LOC exceedances for acute toxic effects to fish, which is used as a surrogate for amphibians. However, chronic LOCs are not exceeded and therefore there is no effect to the aquatic-phase CRLF due to direct chronic toxicity. An LAA determination is made

for indirect effects to CRLF due to reduction in fish and other frogs as food items (for adult frogs). There is “no effect” to the aquatic-phase CRLF for indirect effects resulting from toxicity to aquatic invertebrates, aquatic non-vascular and vascular plants as food and habitat items. RQs were not calculated for terrestrial plants due to lack of appropriate data. However, multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants and the effect determined to be insignificant. Based on open literature data identified by ECOTOX database maintained by EPA/Office of Research and Development (ORD) (U.S. EPA, 2004), captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations. A “may affect, not likely to adversely affect” (NLAA) determination was made for effects to terrestrial plants. Overall, an LAA determination was concluded for the aquatic-phase CRLF, based on direct acute effects and indirect effects to fish and frogs as food items to adult frogs.

For the terrestrial-phase CRLF, an LAA determination was concluded for direct effects based on acute avian toxicity data. The acute and chronic RQs, which represent an upper bound estimate of the risk, exceed the LOC for the frog for all captan uses. Definitive RQs could not be calculated because the avian toxicity data showed no mortality; however, the predicted EECs are approximately three times the adjusted LD₅₀ values for two weight classes that are intended to be representative of juvenile and adult terrestrial-phase CRLFs. In addition, an LAA determination was concluded for indirect effects related to a reduction in mammals and frogs as food items. Given these direct and indirect effects to the CRLF, modification of critical habitat is also expected for both aquatic and terrestrial primary constituent elements (PCEs). A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat is presented in Tables 1.1 and 1.2. Further information on the results of the effects determination is included as part of the Risk Description in Section 5.2.

In addition, to the LAA determination for direct and indirect effects to the CRLF based on LOC exceedances at maximum application rates, it was also demonstrated by spatial analysis that the final action area for captan overlaps with CRLF habitats through direct applications to target areas and runoff and spray drift to non-target areas. The terrestrial action area is buffered by 1001 ft based on spray drift potential at the maximum single application rate (almond) and captan toxicity to terrestrial species. This buffer was applied to the agriculture, orchard/vineyard, and turf land use types in California. Therefore, the terrestrial portion of the captan action area for this assessment includes all potential agricultural, orchard/vineyard, and turf use sites and all areas that are within 1001 ft of potential captan use sites in CA. Based on this analysis, a total of 2,442 km² (or 9%) of the CRLF range overlaps with the terrestrial portion of the captan action area for agricultural and orchard/vineyard uses. In addition, 327 sections (34%) of established occurrence sections of the CRLF overlap with the terrestrial portion of the captan action area for agricultural and orchard/vineyard uses. For turf alone, a total of 1,659 km² (or 6%) of the CRLF range overlaps with the terrestrial portion of the captan action area for turf and 232 sections (25%) of established occurrence sections of the CRLF overlap for

turf. Downstream extent analysis showed that for agriculture, orchard/vineyard, and turf uses, 3,580, 1,477, and 765 kilometers were added to the stream reaches, respectively. Some of these stream reaches overlap with CRLF habitat. Thus, spatial analysis indicates that the uses of captan may result in CRLF exposures in aquatic and terrestrial habitats.

Table 1.1 Effects Determination Summary for Captan - Direct and Indirect Effects to CRLF		
Assessment Endpoint	Effects Determination	Basis For Preliminary Determination
<i>Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)</i>		
<u>Direct Effects</u> Survival, growth, and reproduction of CRLF individuals	LAA	Using freshwater fish as a surrogate, non-listed acute risk LOCs are exceeded, chronic LOCs are not exceeded (Table 5.01).
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects to food supply (<i>i.e.</i> , freshwater invertebrates, non-vascular plants, fish and frogs)	Aquatic invertebrates and non-vascular plants: No Effect	Acute freshwater invertebrate RQs do not exceed acute or chronic LOCs (Tables 5.03). Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02).
	Fish and Frogs: LAA	Non-listed acute risk LOCs are exceeded based on the most sensitive toxicity data for freshwater fish (Table 5.01).
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on habitat, cover, and/or primary productivity (<i>i.e.</i> , aquatic plant community)	No Effect	Aquatic non-vascular plant (Table 5.02) and vascular plant (Table 5.04) RQs do not exceed acute LOCs for all captan uses.
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.
<i>Terrestrial Phase (Juveniles and adults)</i>		
<u>Direct Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on terrestrial phase adults and juveniles	LAA	Although no mortality was observed at the highest test concentrations in the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels and upper-bound RQ values exceed avian non-listed acute risk and chronic LOCs for all uses (Table 5.05).
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on prey (<i>i.e.</i> , terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	LAA	Non-listed acute risk and chronic LOCs are exceeded for mammals and birds. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05, 5.06, and 5.07). Non-listed acute risk LOCs are exceeded based on the most sensitive toxicity data for freshwater fish (Table 5.01) which are a surrogate for terrestrial phase amphibians.
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on habitat (<i>i.e.</i> , riparian vegetation)	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.

Table 1.2 Effects Determination Summary for Captan – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Effects Determination	Basis For Preliminary Determination
<i>Aquatic Phase PCEs</i> <i>(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)</i>		
<u>Indirect Effects</u> Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.
<u>Indirect Effects</u> Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	NLAA (insignificant)	
<u>Indirect Effects</u> Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	<u>Growth and viability of CRLF:</u> Modification	Using freshwater fish as a surrogate, non-listed acute risk LOCs are exceeded for all uses (Table 5.01).
	<u>Food source:</u> No Effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02). Aquatic vascular plant LOCs are not exceeded for applications of captan to all uses (Table 5.04).
<u>Indirect Effects</u> Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	No Effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02).
<i>Terrestrial Phase PCEs</i> <i>(Upland Habitat and Dispersal Habitat)</i>		
<u>Indirect Effects</u> Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.
<u>Indirect Effects</u> Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	NLAA (insignificant)	
<u>Indirect Effects</u> Reduction and/or modification of food sources for terrestrial phase juveniles and	Modification	Non-listed acute and chronic LOCs are exceeded for mammals and birds for all modeled uses of captan. Acute RQs for terrestrial invertebrates also exceed

Table 1.2 Effects Determination Summary for Captan – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Effects Determination	Basis For Preliminary Determination
adults		the LOC for all modeled uses of captan (Tables 5.05 – 5.09).
<u>Indirect Effects</u> Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Modification	Non-listed acute and chronic LOCs are exceeded for mammals and birds for all modeled uses of captan. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05 – 5.09).

When evaluating the significance of this risk assessment’s direct/indirect and habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (i.e., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (i.e., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment’s predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information

described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

2. Problem Formulation

Problem formulation provides a strategic framework for the risk assessment. By identifying the important components of the problem, it focuses the assessment on the most relevant life history stages, habitat components, chemical properties, exposure routes, and endpoints. The structure of this risk assessment is based on guidance contained in U.S. EPA's *Guidance for Ecological Risk Assessment* (U.S. EPA 1998), the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS 1998) and is consistent with procedures and methodology outlined in the Overview Document (U.S. EPA 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS/NMFS 2004).

2.1 Purpose

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the federally threatened California red-legged frog (*Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding use of captan on a number of crops as a seed treatment and as a foliar spray on food and non-food crops including turf and ornamentals. In addition, this assessment evaluates whether these actions can be expected to result in the modification of the species' critical habitat. Key biological information for the CRLF is included in Section 2.5, and designated critical habitat information for the species is provided in Section 2.6 of this assessment. This ecological risk assessment has been prepared as part of the *Center for Biological Diversity (CBD) vs. EPA et al.* (Case No. 02-1580-JSW(JL)) settlement entered in the Federal District Court for the Northern District of California on October 20, 2006.

In this endangered species assessment, direct and indirect effects to the CRLF and potential modification to its critical habitat are evaluated in accordance with the methods (both screening level and species-specific refinements, when appropriate) described in the Agency's Overview Document (U.S. EPA 2004). Screening level methods include use of standard models such as GENEEC, PRZM-EXAMS, TREX, TerrPlant, AgDrift, and AgDisp, all of which are described at length in the Overview Document. Additional refinements include a modification of TREX (T-HERPS) to evaluate effects on terrestrial-phase frogs, an analysis of the usage data, and a spatial analysis. Use of such information is consistent with the methodology described in the Overview Document (U.S. EPA 2004), which specifies that "the assessment process may, on a case-by-case basis, incorporate additional methods, models, and lines of evidence that EPA finds technically appropriate for risk management objectives" (Section V, page 31 of U.S. EPA 2004).

In accordance with the Overview Document, provisions of the ESA, and the Services' *Endangered Species Consultation Handbook*, the assessment of effects associated with registrations of captan are based on an action area. The action area is considered to be

the area directly or indirectly affected by the federal action, as indicated by the exceedance of Agency levels of concern (LOCs) used to evaluate direct or indirect effects. It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of captan may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on the section of the action area that intersects with 1) locations where CLRF is known to occur¹, 2) currently occupied core areas for the CLRF², and 3) designated critical habitat.

As part of the “effects determination,” one of the following three conclusions will be reached regarding the potential for registration of captan at the use sites described in this document to affect CRLF individuals and/or result in the modification of designated CRLF critical habitat:

- “No effect”;
- “May affect, but not likely to adversely affect”; or
- “May affect and likely to adversely affect”.

Critical habitat identifies specific areas that have the physical and biological features, (known as primary constituent elements or PCEs) essential to the conservation of the listed species. The PCEs for CRLFs are aquatic and upland areas where suitable breeding and non-breeding aquatic habitat is located, interspersed with upland foraging and dispersal habitat (Section 2.6).

If the results of initial screening-level assessment methods show no direct or indirect effects (no LOC exceedances) upon individual CRLFs or upon the PCEs of the species’ designated critical habitat, a “no effect” determination is made for the FIFRA regulatory action regarding captan as it relates to this species and its designated critical habitat. If, however, direct or indirect effects to individual CRLFs are anticipated and/or effects may impact the PCEs of the CRLF’s designated critical habitat, a preliminary “may affect” determination is made for the FIFRA regulatory action regarding captan.

If a determination is made that use of captan within the action area(s) associated with the CRLF “may affect” this species or its designated critical habitat, additional information is considered to refine the potential for exposure and for effects to the CRLF and other taxonomic groups upon which these species depend (e.g., aquatic and terrestrial vertebrates and invertebrates, aquatic plants, riparian vegetation, etc.). Additional information, including spatial analysis (to determine the geographical proximity of CRLF habitat and captan use sites) and further evaluation of the potential impact of captan on the PCEs is also used to determine whether modification to designated critical habitat may occur. Based on the refined information, the Agency uses the best available information to distinguish those actions that “may affect, but are not likely to adversely affect” from those actions that “may affect and are likely to adversely affect” the CRLF

¹ As documented in the California Natural Diversity Database (CNDDB)

² As described in the recovery plan.

or the PCEs of its designated critical habitat. This information is presented as part of the Risk Characterization in Section 5 of this document.

The Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because captan is expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for captan is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes (i.e., the biological resource requirements for the listed species associated with the critical habitat or important physical aspects of the habitat that may be reasonably influenced through biological processes). Activities that may modify critical habitat are those that alter the PCEs and appreciably diminish the value of the habitat. Evaluation of actions related to use of captan that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. Actions that may affect the CRLF's designated critical habitat have been identified by the Services and are discussed further in Section 2.6.

2.2 Scope

Captan (PC 081301, CAS Registry # 133-06-2) is a registered non-systemic fungicide used to control diseases generally in orchard and vineyard crops, ginseng, seeds, turf and ornamentals. Captan is registered for several formulations and is applied by various methods, including aerial, airblast, and ground applications. A listing of all of the uses is provided in **Table 2.01**.

The end result of the EPA pesticide registration process (the FIFRA regulatory action) is an approved product label. The label is a legal document that stipulates how and where a given pesticide may be used. Product labels (also known as end-use labels) describe the formulation type (e.g., liquid or granular), acceptable methods of application, approved use sites, and any restrictions on how applications may be conducted. Thus, the use or potential use of captan in accordance with the approved product labels for California is "the action" being assessed.

Although current registrations of captan allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of captan in portions of the action area that are reasonably assumed to be biologically relevant to the CRLF and its designated critical habitat. Further discussion of the action area for the CRLF and its critical habitat is provided in Section 2.7.

Captan is registered as a postharvest dip to apples, cherries and pears and foliar spray for greenhouse or shade house ornamentals. It can be also incorporated into paint and adhesives as an in-can preservative. Homeowner use of captan containing paints and adhesives do not result in a risk concern to the Agency (U.S. EPA, 1999); therefore, they have no effect of the CRLF. Because these uses are expected to pose negligible, if any, exposure to terrestrial or aquatic organisms, they are not included further in this risk assessment. In addition, black-eyed peas, cranberry, lentils, soybean, and tobacco were

not included in this assessment because they are not grown in California. Low seeding rates and pesticide application rates for bluegrass, canola/rape, chard/swiss, cotton, cowpeas, lespedeza, peanuts, peas, sunflower, and trefoil led to expectations that exposure level would be less than the exposure for the major crops. Therefore, these crops were not modeled. The crops sugar beet and sugar beet (with tops) were merged into one sugar beet crop because their modeling input data were identical.

Table 2.01 Registered Uses of Captan				
Foliar Spray, Food Use				
ALMOND	BLUEBERRY	DEWBERRY	MELONS	PLUM
APPLE	CANEERRIES	GINSENG	NECTARINE	PRUNE
APRICOT	CHERRY	GRAPES	PEACH	RASPBERRY
BLACKBERRY		LOGANBERRY	PEAR	(BLACK - RED) STRAWBERRY
Seed treatment, food use				
ALFALFA	CANOLA\RAPE	CUCUMBER	ONION	SQUASH (ALL OR UNSPECIFIED)
BARLEY	CAULIFLOWER	FLAX	PEANUTS (UNSPECIFIED)	SUGAR BEET
BEANS	CHARD - SWISS	GRASS	PEAS	SUGAR BEETS
BEANS - DRIED-TYPE	CLOVER	FORAGE/FODDER/HAY	(UNSPECIFIED)	(INCL. TOPS)
BEANS - SUCCULENT (SNAP)	COLE CROPS	KALE	PEPPER	SUNFLOWER
BEETS (UNSPECIFIED)		LESPEDA	POTATO - WHITE/IRISH	TOMATO
	COLLARDS	MELONS - CANTALOUPE	PUMPKIN	TREFOIL
BLUEGRASS	CORN (UNSPECIFIED)	MELONS - MUSK	RADISH	TURNIP
BROCCOLI	CORN - FIELD	MELONS - WATER	RYE	WHEAT
BRUSSELS SPROUTS	CORN - SWEET	MUSTARD	SORGHUM (UNSPECIFIED)	LAWN SEEDBEDS
CABBAGE	COTTON (UNSPECIFIED)	OATS	SPINACH	
Seed treatment, non-food use				
ALFALFA	BROCCOLI	CLOVER	FLAX	ONION
BARLEY	BRUSSELS SPROUTS	CORN - FIELD	GRASSES GROWN FOR SEED	RADISH
BEANS - DRIED-TYPE	CABBAGE	CORN - SWEET	MELONS - CANTALOUPE	RYE
BEANS - SUCCULENT (SNAP)	CANOLA\RAPE	COTTON (UNSPECIFIED)	MUSTARD	TURNIP
BEETS (UNSPECIFIED)	CAULIFLOWER	CUCUMBER	OATS	WHEAT
Foliar spray/ Preplant Treatment, non-food use				
GOLF COURSE TURF			TURF (SOD FARMS)	
AZALEAS, BEGONIAS, CHRYSANTHEUM, ROSES			DICHONDRA GRASSES	
CAMELLIAS, CARNATIONS			ORNAMENTAL GRASSES IN NON-PASTURED AREAS	

2.2.1 Degradates

Captan degrades rapidly and forms two major degradation products tetrahydrophthalimide (THPI) and tetrahydrophthalimic acid (THPAm). THPI is also degraded into a series of ring products, including tetrahydrophthalimic acid (THPAm). Aquatic toxicity data for THPI and THPAm is available and indicates that the degradates are about four orders of magnitude less toxic than the parent. However, THPI is more persistent than the parent. Tier I screening tool (GENEEC model) was used to estimate EECs, and evaluate the potential for LOC exceedances for aquatic organisms. Since no

exceedance was observed, THPI is not considered further in this assessment (Appendix H).

2.2.2 Mixtures

The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (U.S., EPA 2004; USFWS/NMFS 2004).

Captan is a component of multiple ingredient formulations in various products. These formulations may include lindane, malathion, carbaryl, methochlor, metalaxyl, carboxin, pentachloronitrobenzene (PCNB), and diazinon. A limit dose test was done for several captan formulations but no definitive product LD₅₀ values resulted with associated 95% Confidence Intervals (CIs). Several of the studies resulted in LD₅₀ values greater than the dose tested. Analysis of the available acute oral mammalian LD₅₀ data for multiple active ingredient products relative to the single active ingredient, captan, is provided in **Appendix C**.

As discussed in USEPA (2000) a quantitative component-based evaluation of mixture toxicity requires data of appropriate quality for each component of a mixture. In this mixture evaluation an LD₅₀ with associated 95% CI is needed for the formulated product. The same quality of data is also required for each component of the mixture. Given that the formulated products for captan do not have LD₅₀ data available it is not possible to undertake a quantitative or qualitative analysis for potential interactive effects. However, because the active ingredients are not expected to have similar mechanisms of action, metabolites, or toxicokinetic behavior, it is reasonable to conclude that an assumption of dose-addition would be inappropriate. Consequently, an assessment based on the toxicity of captan is the only scientifically reasonable approach that employs the available data to address the potential acute risks of the formulated products.

2.3 Previous Assessments

Captan was first registered as a pesticide under the Federal Insecticide, Fungicide and Rodenticide Act in 1951 for the control of fungal diseases of fruit crops. Prior to 1980, there were many use-patterns registered and tolerances established for this broad spectrum fungicide. Currently, there are 159 registered products (including 17 State and Local Needs) containing captan.

The Captan Reregistration Eligibility Decision (RED) document was completed in September 1999. The Agency assessment determined that the data were sufficient to support reregistration of products containing captan, except for those with uses on turf and aerially-applied wettable powder formulations. Products applied to turf at sod farms or golf courses were eligible for reregistration; uses at all other turf sites were voluntarily cancelled. Wettable powder formulations that are applied aerially are eligible for reregistration, provided either: 1) the products are packaged in water soluble packaging; or 2) the application rates are reduced to a level that is no higher than 1.2 lb ai/A.

On November 1, 2004, an amendment to the RED was issued with the following ecological risk mitigation included:

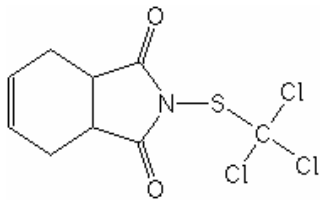
- The dichondra ornamental grass, golf course turf, and turf sod farm use rates are reduced from a single application rate of 43 pounds active ingredient per acre to 4.3 pounds active ingredient per acre. Two applications per year are allowed for a seasonal maximum application rate of 8.6 pounds of active ingredient per acre.
- Spray Drift language has been modified. An additional requirement for a maximum nozzle height of 4 feet above the crop canopy with ground boom application has been added.
- Application restrictions for products used on turf have been expanded to specify a prohibition on applications to turf in residential sites, apartment buildings, daycare centers, playgrounds, sports fields, or other residential areas.

2.4 Stressor Source and Distribution

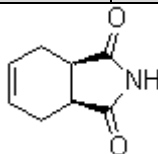
2.4.1 Environmental Fate Assessment

Selected physical, chemical, and environmental fate properties of captan are listed in **Table 2.02**. Captan is a non-volatile (8×10^{-8} mm Hg at 25°C) and low solubility (3.3 mg/L at 25°C) in water. Captan has a relatively short half-life ($t_{1/2}$ =1 to 10 days) in soil and aquatic environments. Abiotic hydrolysis and aerobic metabolism appear to be the major routes of captan dissipation in the environment. In both soil and water, the sulfur-nitrogen bond cleaves, thus separating the trichloromethylthio (TCMT) and tetrahydrophthalamide (THPI) moieties of the molecule. The TCMT moiety degrades by aerobic soil metabolism to form CO₂, thiophosgene, and inorganic sulfur and chlorine. Dissipation of thiophosgene is expected to be controlled by volatilization (est. vapor pressure=29.7 mm Hg and estimated Henry's Law Constant of 0.00586 atm•M⁻³ mole⁻¹). It should be noted that thiophosgene was not detected as a volatile component in any of the submitted laboratory studies for captan.

Table 2.02 Selected Physical and Chemical Properties of Captan

Parameter	Value and Unit	Sources
Chemical Structure		
Chemical Name	Captan	
Smiles notation	3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-1H-isoindole-1,3(2H)-dione	
CAS Number	133-06-2	
PC Code	081301	
Molecular Formula	C ₉ H ₈ Cl ₃ NO ₂ S	Product Chemistry
Molecular Weight	300.57 gram/mol	Product Chemistry
Appearance	Solid	Product Chemistry
Color	White	Product Chemistry
Odor	No odor	Product Chemistry
Melting Point	178°C (pure compound); 158-170°C (technical grade, 90-95% pure)	Product Chemistry
Vapor pressure	8 x 10 ⁻⁸ mm Hg at 25°C	Product Chemistry
Water Solubility (pH 7, 25°C)	3.3 mg/L at 25°C	Product Chemistry
Henry's law constant (K _H)	9.6E-10 Atm.M ³ Mol ⁻¹	Estimated
Octanol/Water Partition Coefficient logK _{ow}	2.79	EPISUITE
Hydrolysis (pH 5, 7, and 9)	0.8, 0.25, 0.006 days	MRIDs 40208101, 41176301, 00096974
Soil K _d	3-8 ml/g	MRIDs 4065801, 4368911
Aerobic Aquatic Metabolism	<1.0 days	MRIDs 40114502
Aerobic soil half-life	<1.00 days	MRID 40658007
Anaerobic soil half-life	1.85 days	MRID 00098881
Photolysis half-life (pH 7)	0.42 days	MRIDs 40208102, 41176301

THPI is rapidly degraded by aerobic soil metabolism to a series of ring-containing products (including THPAm) and ultimately CO₂ (MRID 38689-02). Freundlich K_d values for THPI ranged from 0.04-0.23 L/kg in six soils (MRID 438689-11). THPI is expected to move with surface water runoff or leaching into the soil (**Table 2.03**). Evidence indicates that residues of THPI may be present in soil several weeks following captan application.

Table 2.03 Environmental fate properties for the degradate, THPI		
Parameters	Values and Unit	Sources
Chemical Structure		
Chemical Name 1,2,3,6-Tetrahydrophthalimide		
Soil Partition Coefficient (Kd)	0.04 – 0.23 ml/g	MRID 438689-11
Molecular Weight	151.6	Product Chemistry
Solubility (25° C) x 100	10ppm	Estimated
Aerobic Soil Metabolism T _{1/2}	6-19.5 days	MRID 3868902
Aerobic Aquatic Metabolism Half-Life	21 days	MRID 00098881

Captan photodegradation on soil also occurs, but is secondary to hydrolysis and aerobic soil metabolism. K_d values of 3.0 to 8.0 ml/g indicate that captan is generally expected to have moderate mobility in soil. In terrestrial field studies, however, captan was shown to be relatively immobile to slightly mobile at 6 different field sites.

Captan has a low potential for bioaccumulation in fish due to rapid hydrolysis in aquatic environments and low log K_{ow} (2.79) (**Table 2.02**). Captan residues had fish bioconcentration factors (BCF) of 102X, 126X, and 113X for edible, non-edible, and whole fish tissue, respectively. After a 14-day depuration period, captan residues in edible tissue, non-edible tissue, and whole fish declined by 94%, 96%, and 95%, respectively.

In terrestrial field dissipation study, parent captan dissipates with half-lives of 2.5 to 24 days and was relatively immobile to slightly mobile at six sites. The maximum depth at which captan was detected was 6-12 inches. The degradate THPI was detected at all sites and declined to less than detectable (0.01 ppm) levels between 14 and 184 days after the final captan treatment. THPI was not detected below 12 inches of soil profiles.

2.4.2 Environmental Transport Assessment

Potential transport mechanisms include pesticide surface water runoff, spray drift, and secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. The magnitude of pesticide transport via secondary drift depends on the pesticide's ability to be mobilized into air and its eventual removal through wet and dry deposition of gases/particles and photochemical reactions in the atmosphere.

A number of studies have documented atmospheric transport and redeposition of pesticides from the Central Valley to the Sierra Nevada mountains (Fellers et al., 2004, Sparling et al., 2001, LeNoir et al., 1999, and McConnell et al., 1998). Prevailing winds blow across the Central Valley eastward to the Sierra Nevada mountains, transporting

airborne industrial and agricultural pollutants into Sierra Nevada ecosystems (Fellers et al., 2004, LeNoir et al., 1999, and McConnell et al., 1998). Therefore, physicochemical properties of the pesticide that describe its potential to enter the air from water or soil (e.g., Henry's Law constant and vapor pressure), pesticide use, modeled estimated concentrations in water and air, and available air monitoring data from the Central Valley and the Sierra Nevadas are considered in evaluating the potential for atmospheric transport of captan to habitat for the CRLF.

Captan has low potential for volatility and measured concentrations were below the level of detection in air monitoring samples, therefore long range transport is unlikely. AgDRIFT and AGDISP are used to estimate deposition of captan from local spray drift on terrestrial habitats that neighbor application sites. In general, deposition of drifting pesticides is expected to be greatest close to the site of application.

2.4.3 Mechanism of Action

Captan is a non-systemic, phthalimide fungicide used to control fungal diseases of many fruit, ornamental, and vegetable crops. The mode of action of captan is inhibition of normal cell division of a broad spectrum of microorganisms and fungi. Captan is known as a stressor to aquatic organisms (fish, invertebrates, mollusks, amphibians, and benthic dwellers) and to lesser degree mammals by limiting and ultimately inhibiting the process of *oxidative phosphorylation*, which is needed for respiration in aquatic organisms as well as terrestrial organisms and humans (Cremlyn, 1996; Johnson and Finaly, 1980).

2.4.4 Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current label for captan represents the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs. Captan is used as a foliar spray on strawberry, ginseng, and several orchard and vineyard crops (**Table 2.04**). Captan is also used as a foliar, dip and seedbed treatment to turf and ornamental grasses and flowers (**Table 2.05**). It is also used as a seed treatment for food and non-food uses (**Table 2.06**).

Estimations were made for the number of applications per year for ornamental grasses. Ornamental grasses in non-pasture areas are treated for several diseases and can be sprayed beginning at spring and applied throughout the season. The maximum single application rate for ornamental grasses is 4.3 lb a.i./A. The maximum annual application rate and number of applications were not specified on the Drexel Chemical Company labels; therefore it was estimated for this assessment that the season for grasses would last approximately seven months in California. The maximum of 26 annual applications with 7-day intervals was modeled (**Table 2.05**).

Application to ornamental flowers was not assessed because environmental exposure is expected to be lower than that due to ornamental grass and turf uses. In addition, many of these flowers are treated in greenhouses or shade houses which results in minimal environmental exposure (Section 3.1).

Table 2.04 Captan Foliar Application to Food Uses				
CROP	Max. Application Rate (lbs ai/A)	Max. # of Applications	Min. Interval Between Apps. (days)	Max. Annual Use Rate (lbs ai)
STRAWBERRY	3.0	8	7	24.00
GINSENG	2.0	8	7	16.00
Orchard Crops				
ALMOND	4.5	4	7	20.00
APPLE	4.0	8	5	32.00
APRICOT	2.5	5	5	12.50
CHERRY	2.0	7	7	14.00
NECTARINE	4.0	6	3	24.00
PEACH	4.0	8	3	32.00
PLUM/ PRUNE	3.0	9	7	27.00
Vineyard Crops				
BLACKBERRY/ CANE BERRY/ RASPBERRY/	2.0	5	10	10.00
DEWBERRY	3.13	3	10	9.39
LOGANBERRY	1.956	5	3	9.78
BLUEBERRY	2.5	14	7	35.00
GRAPES	2.0	6	10	12.00

Table 2.05. Application Rates for Use of Captan on Ornamentals					
Use	Disease	Application rate (lb a.i./A)¹	Number of Applications per year	Interval	Instructions
Azaleas, Begonias (tuberous), Chrysanthemum	Damping-off of cuttings	2	1	--	Dip cuttings/ tubers before bedding
Gladiolus (Corms)	Corm rot and decay, damping-off	2.5 – 7.5	1	--	Dip corms before planting
Azaleas	Petal Blight	1	Approximately 5	7	Spray flowers/ soil through bloom (~5 weeks)
Camellias	Petal Blight	0.5	Approximately 12	7	Spray soil through bloom (~3 months)
Chrysanthemum, Roses, Carnations	Botrytis flower blight, Septoria leaf spot, black spot, Alternaria leaf spot, rust	1	Approximately 26 for roses ²	7	Spray flowers at first sign of disease (roses- all year, mums approx. 7 – 10 weeks)
Grasses (Ornamental in non-pastured areas only)	Brown patch, brown spot, damping off, leaf spot, melting out, seedling blight	4.36	Approximately 26 ²	7	Start at spring growth and apply throughout the season
Grasses (lawn seedbeds)	Damping off, other soil borne diseases	6.53	1	--	Cultivate in top 3-4 inches of soil before planting
Soil and Greenhouse bench treatment	Damping-off, root rot	6.53	1	--	Preplant treatment on seedlings or transplants of roses (or other shrubs, trees, flowers) and lawn seedbeds. Cultivate in top 3-4 inches of soil before planting
Turf (Golf Course), Sod Farms, Dichondra	White mold, damping off, leaf spot	4.3 lb ai/A	2	7	Max App Rate is 8.6 lb ai/A

¹ Assumes 100 gallons is used on one acre as stated on Captan label (EPA Reg. 066330-239)

² Label does not indicate a maximum number of applications or annual rate; therefore, the maximum of 26 applications was chosen

Table 2.06. Application Rates for Seed Treatment using Captan				
Crop	Captan Application Rate (lbs. Ai/cwt)	Seeding Rate ¹ (lbs/acre)	Converted Captan Application (lb a.i./A) ²	Planting Depth (in) Used in Model
ALFALFA	0.2578	35	0.09023	1.00
BARLEY	0.0938	100	0.0938	1.00
BEETS (UNSPECIFIED)	0.375	3	0.01125	1.00
BROCCOLI	0.0656	1.5	0.000984	1.00
BRUSSELS SPROUTS	0.0656	1	0.000656	1.00
CABBAGE	0.0656	1.5	0.000984	1.00
CAULIFLOWER	0.0656	1.5	0.000984	1.00
CLOVER	0.2578	30	0.07734	0.50
COLLARDS	0.0293	4	0.001172	1.00
CUCUMBER	0.0969	3	0.002907	1.00
FLAX	0.1219	50	0.06095	1.00
GRASS FORAGE/FODDER/HAY	0.2578	435	1.12143	1.00
KALE	0.0293	5	0.001465	1.00
MELONS - CANTALOUPE	0.0969	4	0.003876	1.00
MELONS - MUSK	0.0625	4	0.0025	1.00
MELONS - WATER	0.0625	2.5	0.0015625	1.00
MUSTARD	0.0625	20	0.0125	1.00
OATS	0.125	96	0.12	1.00
ONION	0.7875	4	0.0315	1.00
PEPPERS	0.0938	2	0.001876	1.00
POTATO - WHITE/IRISH	0.0513	2,800	1.4364	1.00
RADISH	0.0656	25	0.0164	1.00
RYE	0.0938	150	0.1407	1.00
SPINACH	0.2031	25	0.050775	1.00
SQUASH (ALL OR UNSPECIFIED)	0.0625	4	0.0025	1.00
TOMATO	0.0546	0.5	0.000273	1.00
TURNIP	0.0906	3	0.002718	1.00
WHEAT	0.125	135	0.16875	1.00

¹ References for the seeding rate information can be found in Appendix B.

² The values in the Captan Maximum Application Rate (lbs a.i. /A) column are the product of the Captan Application Rate (lb a.i. /cwt) multiplied by the Seeding Rate (lb/A).

A national map (**Figure 1**) showing the estimated poundage of captan uses across the United States is provided below. The map was downloaded from the U.S. Geological Survey (USGS), National Water Quality Assessment (NAWQA) Program (http://ca.water.usgs.gov/pnsp/pesticide_use_maps/). On a national level the highest uses are apples, strawberries, peaches, and blueberries. For California, captan use is heaviest in the Central Valley and coastal areas.

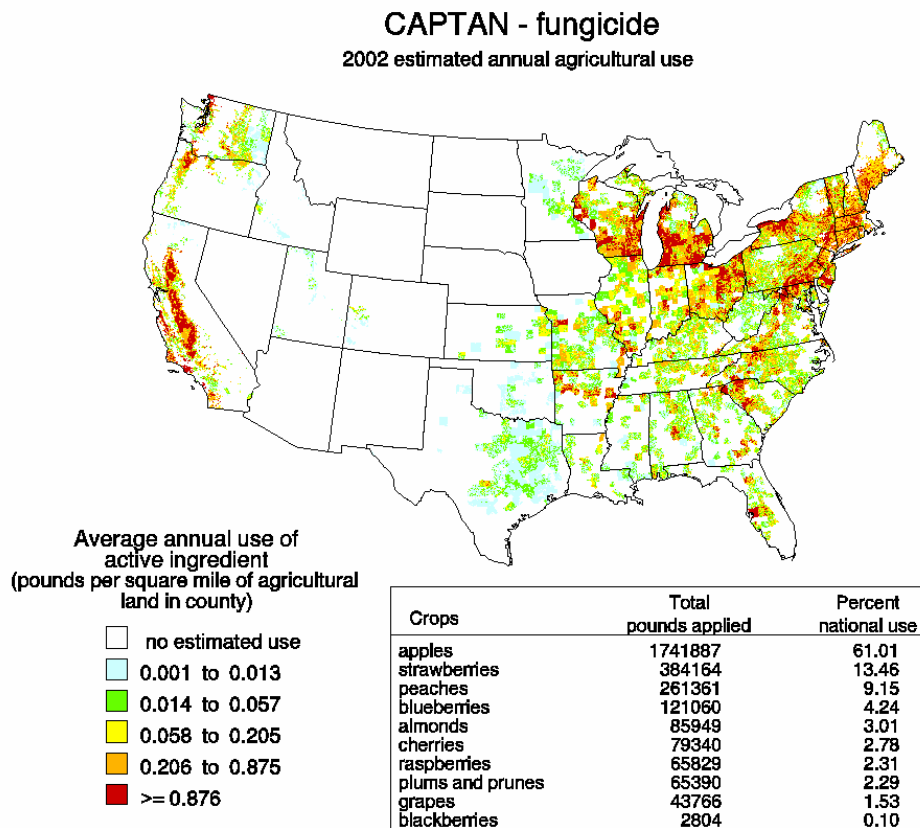


Figure 1. National Captan Use from the U.S. Geological Survey (USGS), National Water Quality Assessment Program (http://ca.water.usgs.gov/pnsp/pesticide_use_maps/)

The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information (Captan LUIS report, 2007) using state-level usage data obtained from USDA-NASS³, Doane (www.doane.com; the full dataset is not provided due to its proprietary nature), and the California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database⁴. CDPR PUR is considered a more comprehensive source of usage data than USDA-NASS or EPA proprietary databases, and thus the usage data reported for captan by county in this California-specific assessment were generated using CDPR PUR data. Usage data are

³ United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) Chemical Use Reports provide summary pesticide usage statistics for select agricultural use sites by chemical, crop and state. See <http://www.usda.gov/nass/pubs/estindx1.htm#agchem>.

⁴ The California Department of Pesticide Regulation's Pesticide Use Reporting database provides a census of pesticide applications in the state. See <http://www.cdpr.ca.gov/docs/pur/purmain.htm>.

averaged together over the years 2002 to 2005 to calculate average annual usage statistics by county and crop for captan, including pounds of active ingredient applied and base acres treated. California State law requires that most pesticide application be reported to the state and made available to the public. According to the PUR database, the average annual number of pounds applied during 2002 - 2005 were 426,171 pounds of captan (**Figure 2**). The largest captan usage at the county-level is strawberries in Ventura County averaging 102,351 pounds annually during the four year period. The next highest captan crop usage by county is strawberries in Monterey, Orange, and Santa Barbara Counties (**Figure 3**). Strawberries, almonds, prunes, grapes, non-outdoor transplants, and peaches account for over 98% of captan use in California for the years 2002 to 2005 (**Figure 4**). A summary of captan usage for all use sites, including both agricultural and non-agricultural, is provided below in **Table 2.07**. The use of captan was reported in 45 counties during this four year period. The annual average pounds for each crop were summed for each county. The annual average application rate was presented as a range for the counties analyzed.

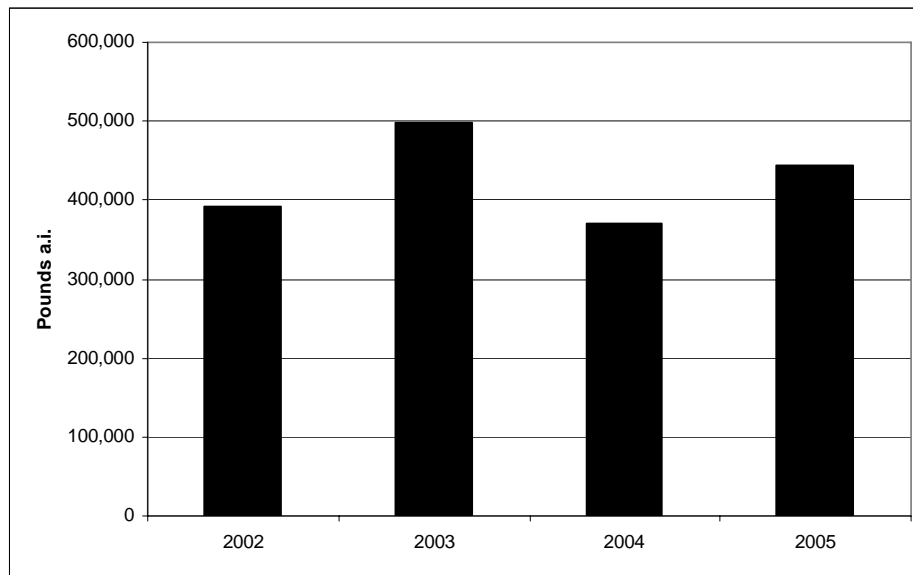


Figure 2. Captan Usage in California, PUR Data

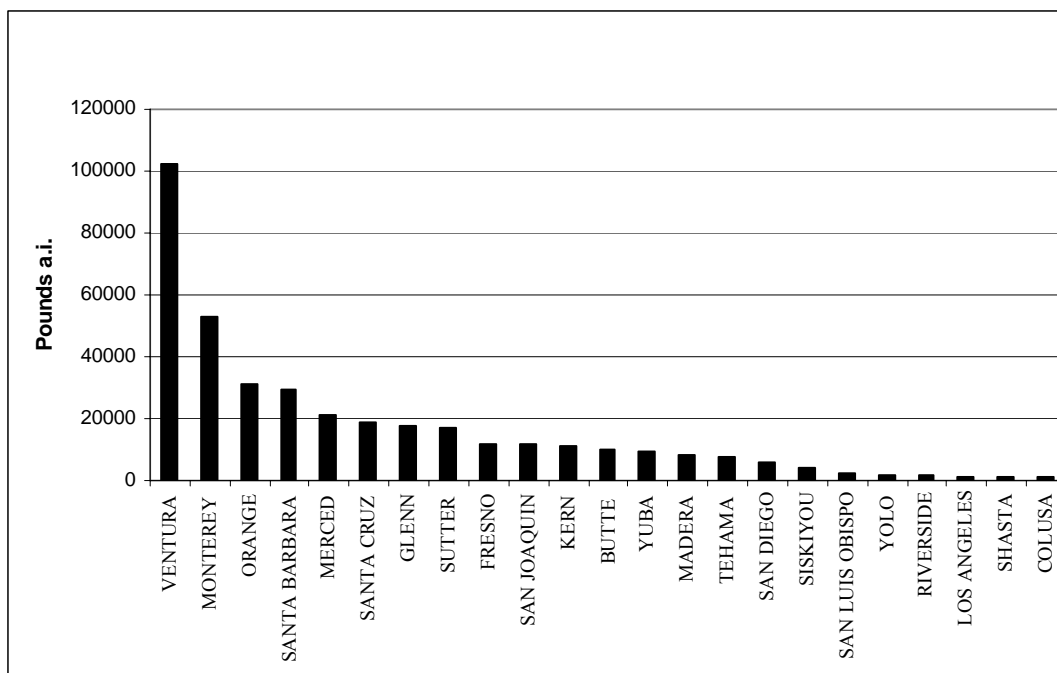


Figure 3. Captan Usage in California by County (2002 – 2005)

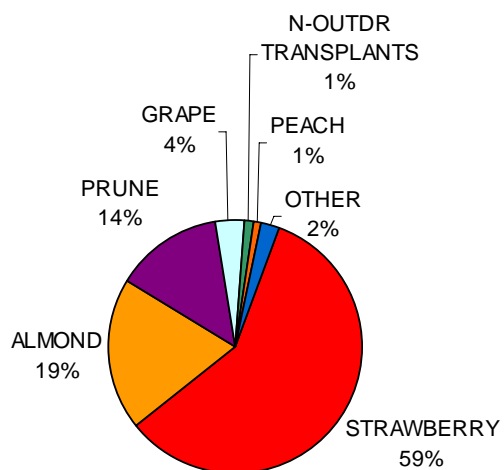


Figure 4. Crops with Highest Captan Usage in California (Cal PUR Data)

Table 2.07. California County Level PUR Data for Captan				
Crop (# counties included in analysis)	Total Average Annual Pounds Applied (summed for all counties)	Range of Average Application Rate for all counties (lb a.i./A)	Average 95% Application Rate (lb a.i./A)	Average Maximum Application Rate (lb a.i./A)
Strawberry (20 Counties)	249,768	0.7 – 3.8	2.6	7.0
Almond (15 counties)	82,550	0.1-3.3	3.6	6.1
Prune (14 Counties)	59,692	2.2 – 2.9	3.1	6.8
Grape (10 Counties)	15,186	1.0-3.4	3.1	5.0
Non-Outdoor Transplants (12 Counties)	4,308	0.3 – 2.6	2.1	4.4
Peach (16 Counties)	4,145	0.2-11.0	3.5	5.3
Nectarine (9 Counties)	2,193	1.0 -2.9	3.5	3.5
Plum (11 Counties)	1,875	1.4 - 3.1	2.8	4.6
Apple (16 Counties)	933	0.2- 3.9	2.2	2.2
Non-Outdoor Flower (9 Counties)	567	0.2 – 6.7	6.1	6.6
Landscape Maintenance (16 Counties)	423	N/A	N/A	N/A
Sudan grass (3 Counties)	301	N/A	N/A	N/A
Grape, Wine (11 Counties)	219	0.1 – 1.7	1.1	1.1
Cherry (9 Counties)	168	0.9 – 3.0	2.2	2.2
Blueberry (5 Counties)	167	0.7 – 2.0	2.1	2.1
Corn (Forage- Fodder) (11 Counties)	107	<0.1 – 0.1	0.1	0.1
Unknown (3 Counties)	105	2.9	2.9	2.9
Non-Outdoor Plants in Containers (14 Counties)	103	<0.1 - 4.9	2.2	3.2
Non-Greenhouse Flower (10 Counties)	96	0.6 – 16.8	10.7	11.5
Apricot (4 Counties)	44	0.9 – 2.4	1.7	2.0
Non-Greenhouse	26	<0.01 - 7.9	5.5	5.5

Table 2.07. California County Level PUR Data for Captan				
Crop (# counties included in analysis)	Total Average Annual Pounds Applied (summed for all counties)	Range of Average Application Rate for all counties (lb a.i./A)	Average 95% Application Rate (lb a.i./A)	Average Maximum Application Rate (lb a.i./A)
Plants in Containers (13 Counties)				
Cotton (5 Counties)	26	<0.1 – 0.2	0.1	0.1
Broccoli (1 County)	19	1.2	2.0	2.0
Non-Greenhouse Transplants (7 County)	16	<0.1 – 4.7	2.5	2.5
Safflower (3 Counties)	14	<0.1	<0.1	<0.1
Uncultivated Non-agriculture (1 County)	13	1.0	1.4	1.4
Oats (1 County)	12	N/A	N/A	N/A
Cantaloupe (2 Counties)	6.6	<0.1	0.1	0.1
Corn (Human Consumption) (4 Counties)	6.6	<0.1	<0.1	<0.1
Raspberry (2 Counties)	3.7	0.6 – 2.0	3.0	3.0
Squash (2 Counties)	2.5	0.5	0.5	0.5

2.5 Assessed Species

The CRLF was federally listed as a threatened species by USFWS effective June 24, 1996 (USFWS 1996). It is one of two subspecies of the red-legged frog and is the largest native frog in the western United States (USFWS 2002). A brief summary of information regarding CRLF distribution, reproduction, diet, and habitat requirements is provided in Sections 2.5.1 through 2.5.4, respectively. Further information on the status, distribution, and life history of and specific threats to the CRLF is provided in Attachment 1.

Final critical habitat for the CRLF was designated by USFWS on April 13, 2006 (USFWS 2006; 71 FR 19244-19346). Further information on designated critical habitat for the CRLF is provided in Section 2.6.

2.5.1 Distribution

The CRLF is endemic to California and Baja California (Mexico) and historically inhabited 46 counties in California including the Central Valley and both coastal and

interior mountain ranges (USFWS 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (USFWS 1996). The species has an elevational range of near sea level to 1,500 meters (5,200 feet) (Jennings and Hayes 1994); however, nearly all of the known CRLF populations have been documented below 1,050 meters (3,500 feet) (USFWS 2002).

Populations currently exist along the northern California coast, northern Transverse Ranges (USFWS 2002), foothills of the Sierra Nevada (5-6 populations), and in southern California south of Santa Barbara (two populations) (Fellers 2005a). Relatively larger numbers of CRLFs are located between Marin and Santa Barbara Counties (Jennings and Hayes 1994). A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS 1996). Occupied drainages or watersheds include all bodies of water that support CRLFs (i.e., streams, creeks, tributaries, associated natural and artificial ponds, and adjacent drainages), and habitats through which CRLFs can move (i.e., riparian vegetation, uplands) (USFWS 2002).

The distribution of CRLFs within California is addressed in this assessment using four categories of location including recovery units, core areas, designated critical habitat, and known occurrences of the CRLF reported in the California Natural Diversity Database (CNDDDB) that are not included within core areas and/or designated critical habitat (**Figure 5**). Recovery units, core areas, and other known occurrences of the CRLF from the CNDDDB are described in further detail in this section, and designated critical habitat is addressed in Section 2.6. Recovery units are large areas defined at the watershed level that have similar conservation needs and management strategies. The recovery unit is primarily an administrative designation, and land area within the recovery unit boundary is not exclusively CRLF habitat. Core areas are smaller areas within the recovery units that comprise portions of the species' historic and current range and have been determined by USFWS to be important in the preservation of the species. Designated critical habitat is generally contained within the core areas, although a number of critical habitat units are outside the boundaries of core areas, but within the boundaries of the recovery units. Additional information on CRLF occurrences from the CNDDDB is used to cover the current range of the species not included in core areas and/or designated critical habitat, but within the recovery units.

Recovery Units

Eight recovery units have been established by USFWS for the CRLF. These areas are considered essential to the recovery of the species, and the status of the CRLF “may be considered within the smaller scale of the recovery units, as opposed to the statewide range” (USFWS 2002). Recovery units reflect areas with similar conservation needs and population statuses, and therefore, similar recovery goals. The eight units described for the CRLF are delineated by watershed boundaries defined by US Geological Survey hydrologic units and are limited to the elevational maximum for the species of 1,500 m above sea level. The eight recovery units for the CRLF are listed in **Table 2.08** and shown in **Figure 5**.

Core Areas

USFWS has designated 35 core areas across the eight recovery units to focus their recovery efforts for the CRLF (see Figure 2.05). **Table 2.08** summarizes the geographical relationship among recovery units, core areas, and designated critical habitat. The core areas, which are distributed throughout portions of the historic and current range of the species, represent areas that allow for long-term viability of existing populations and reestablishment of populations within historic range. These areas were selected because they: 1) contain existing viable populations; or 2) they contribute to the connectivity of other habitat areas (USFWS 2002). Core area protection and enhancement are vital for maintenance and expansion of the CRLF's distribution and population throughout its range.

For purposes of this assessment, designated critical habitat, currently occupied (post-1985) core areas, and additional known occurrences of the CRLF from the CNDDDB are considered. Each type of location information is evaluated within the broader context of recovery units. For example, if no labeled uses of captan occur (or if labeled uses occur at predicted exposures less than the Agency's LOCs) within an entire recovery unit, a "no effect" determination would be made for all designated critical habitat, currently occupied core areas, and other known CNDDDB occurrences within that recovery unit. Historically occupied sections of the core areas are not evaluated as part of this assessment because the USFWS Recovery Plan (USFWS 2002) indicates that CRLFs are extirpated from these areas. A summary of currently and historically occupied core areas is provided in **Table 2.08** (currently occupied core areas are bolded). While core areas are considered essential for recovery of the CRLF, core areas are not federally-designated critical habitat, although designated critical habitat is generally contained within these core recovery areas. It should be noted, however, that several critical habitat units are located outside of the core areas, but within the recovery units. The focus of this assessment is currently occupied core areas, designated critical habitat, and other known CNDDDB CRLF occurrences within the recovery units. Federally-designated critical habitat for the CRLF is further explained in Section 2.6.

Table 2.08. California Red-legged Frog Recovery Units with Overlapping Core Areas and Designated Critical Habitat				
Recovery Unit ¹ (Figure 2.a)	Core Areas ^{2,7} (Figure 2.a)	Critical Habitat Units ³	Currently Occupied (post-1985) ⁴	Historically Occupied ⁴
Sierra Nevada Foothills and Central Valley (1) (eastern boundary is the 1,500m elevation line)	Cottonwood Creek (partial) (8)	--	✓	
	Feather River (1)	BUT-1A-B	✓	
	Yuba River-S. Fork Feather River (2)	YUB-1	✓	
	--	NEV-1 ⁶		
	Traverse Creek/Middle Fork American River/Rubicon (3)	--	✓	
	Consumnes River (4)	ELD-1	✓	
	S. Fork Calaveras River (5)	--		✓
	Tuolumne River (6)	--		✓
	Piney Creek (7)	--		✓
	East San Francisco Bay (partial)(16)	--	✓	
North Coast Range Foothills and Western Sacramento River Valley (2)	Cottonwood Creek (8)	--	✓	
	Putah Creek-Cache Creek (9)	--		✓
	Jameson Canyon – Lower Napa Valley (partial) (15)	--	✓	
	Belvedere Lagoon (partial) (14)	--	✓	
	Pt. Reyes Peninsula (partial) (13)	--	✓	
North Coast and North San Francisco Bay (3)	Putah Creek-Cache Creek (partial) (9)	--		✓
	Lake Berryessa Tributaries (10)	NAP-1	✓	
	Upper Sonoma Creek (11)	--	✓	
	Petaluma Creek-Sonoma Creek (12)	--	✓	
	Pt. Reyes Peninsula (13)	MRN-1, MRN-2	✓	
	Belvedere Lagoon (14)	--	✓	
	Jameson Canyon-Lower Napa River (15)	SOL-1	✓	
South and East San Francisco Bay (4)	--	CCS-1A ⁶		
	East San Francisco Bay (partial) (16)	ALA-1A, ALA- 1B, STC-1B	✓	
	--	STC-1A ⁶		
	South San Francisco Bay (partial) (18)	SNM-1A	✓	
Central Coast (5)	South San Francisco Bay (partial) (18)	SNM-1A, SNM- 2C, SCZ-1	✓	
	Watsonville Slough- Elkhorn Slough (partial) (19)	SCZ-2 ⁵	✓	
	Carmel River-Santa Lucia (20)	MNT-2	✓	
	Estero Bay (22)	--	✓	

	--	SLO-8 ⁶		
	Arroyo Grande Creek (23)	--	✓	
	Santa Maria River-Santa Ynez River (24)	--	✓	
Diablo Range and Salinas Valley (6)	East San Francisco Bay (partial) (16)	MER-1A-B, STC-1B	✓	
	--	SNB-1 ⁶ , SNB-2 ⁶		
	Santa Clara Valley (17)	--	✓	
	Watsonville Slough- Elkhorn Slough (partial)(19)	MNT-1	✓	
	Carmel River-Santa Lucia (partial)(20)	--	✓	
	Gablan Range (21)	SNB-3	✓	
	Estrella River (28)	SLO-1A-B	✓	
Northern Transverse Ranges and Tehachapi Mountains (7)	--	SLO-8 ⁶		
	Santa Maria River-Santa Ynez River (24)	STB-4, STB-5, STB-7	✓	
	Sisquoc River (25)	STB-1, STB-3	✓	
	Ventura River-Santa Clara River (26)	VEN-1, VEN-2, VEN-3	✓	
	--	LOS-1 ⁶		
Southern Transverse and Peninsular Ranges (8)	Santa Monica Bay-Ventura Coastal Streams (27)	--	✓	
	San Gabriel Mountain (29)	--		✓
	Forks of the Mojave (30)	--		✓
	Santa Ana Mountain (31)	--		✓
	Santa Rosa Plateau (32)	--	✓	
	San Luis Rey (33)	--		✓
	Sweetwater (34)	--		✓
	Laguna Mountain (35)	--		✓
¹ Recovery units designated by the USFWS (USFWS 2000, pg 49). ² Core areas designated by the USFWS (USFWS 2000, pg 51). ³ Critical habitat units designated by the USFWS on April 13, 2006 (USFWS 2006, 71 FR 19244-19346). ⁴ Currently occupied (post-1985) and historically occupied core areas as designated by the USFWS (USFWS 2002, pg 54). ⁵ Critical habitat unit where identified threats specifically included pesticides or agricultural runoff (USFWS 2002). ⁶ Critical habitat units that are outside of core areas, but within recovery units. ⁷ Currently occupied core areas that are included in this effects determination are bolded.				

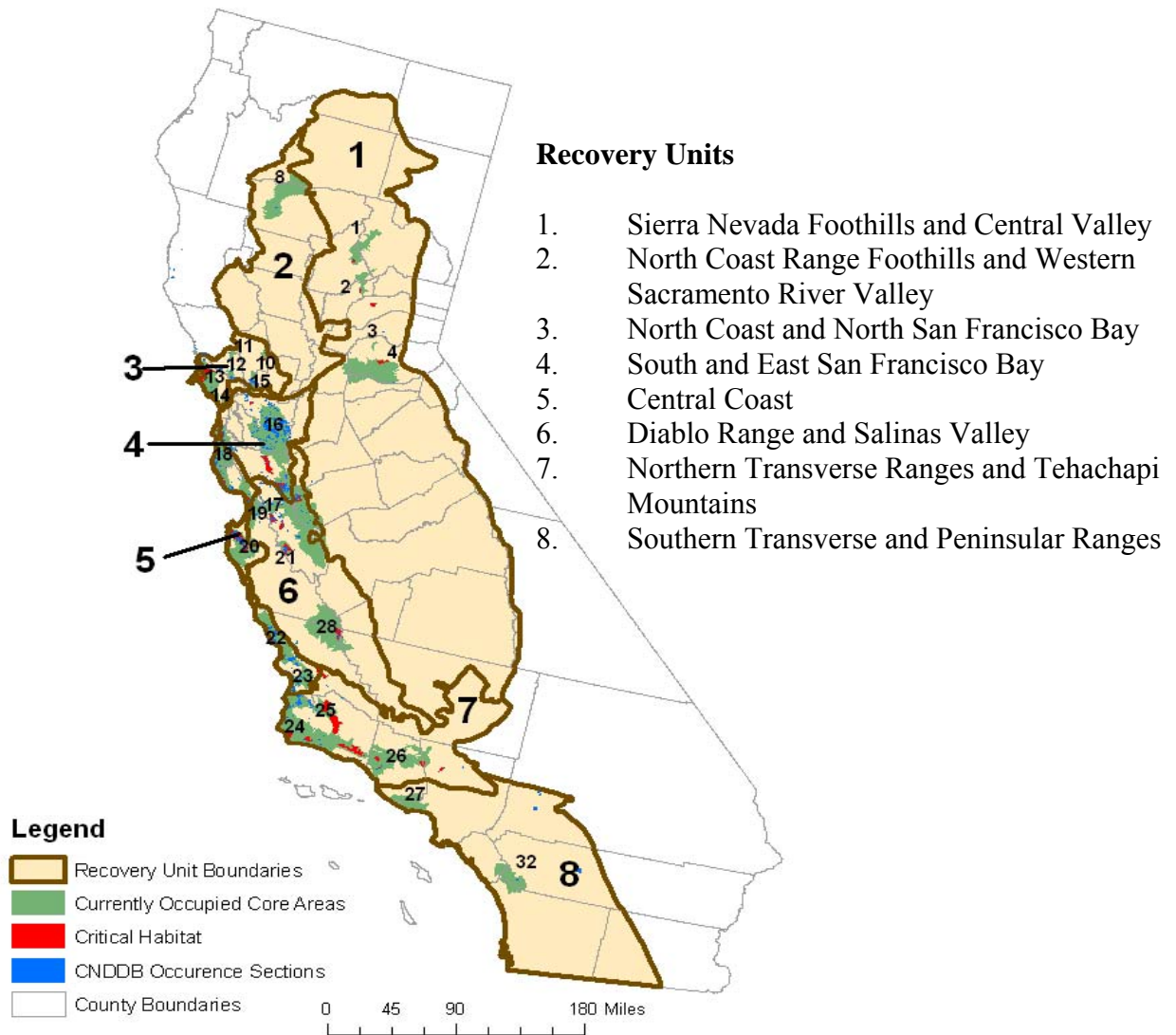


Figure 5. Recovery Unit, Core Area, Critical Habitat, and Occurrence Designations for CRLF (* Core areas that were historically occupied by the California red-legged frog are not included in the map)

Core Areas

1. Feather River
2. Yuba River- S. Fork Feather River
3. Traverse Creek/ Middle Fork/ American R. Rubicon
4. Cosumnes River
5. South Fork Calaveras River*
6. Tuolumne River*
7. Piney Creek*
8. Cottonwood Creek
9. Putah Creek – Cache Creek*
10. Lake Berryessa Tributaries
11. Upper Sonoma Creek
12. Petaluma Creek – Sonoma Creek
13. Pt. Reyes Peninsula
14. Belvedere Lagoon
15. Jameson Canyon – Lower Napa River
16. East San Francisco Bay
17. Santa Clara Valley
18. South San Francisco Bay
19. Watsonville Slough-Elkhorn Slough
20. Carmel River – Santa Lucia
21. Gablan Range
22. Estero Bay
23. Arroyo Grange River
24. Santa Maria River – Santa Ynez River
25. Siquoc River
26. Ventura River – Santa Clara River
27. Santa Monica Bay – Venura Coastal Streams
28. Estrella River
29. San Gabriel Mountain*
30. Forks of the Mojave*
31. Santa Ana Mountain*
32. Santa Rosa Plateau
33. San Luis Ray*
34. Sweetwater*
35. Laguna Mountain*

Other Known Occurrences from the CNDBB

The CNDBB provides location and natural history information on species found in California. The CNDBB serves as a repository for historical and current species location sightings. Information regarding known occurrences of CRLFs outside of the currently occupied core areas and designated critical habitat is considered in defining the current range of the CRLF. See: http://www.dfg.ca.gov/bdb/html/cnddb_info.html for additional information on the CNDBB.

2.5.2 Reproduction

CRLFs breed primarily in ponds; however, they may also breed in quiescent streams, marshes, and lagoons (Fellers 2005a). According to the Recovery Plan (USFWS 2002), CRLFs breed from November through late April. Peaks in spawning activity vary geographically; Fellers (2005b) reports peak spawning as early as January in parts of coastal central California. Eggs are fertilized as they are being laid. Egg masses are typically attached to emergent vegetation, such as bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.) or roots and twigs, and float on or near the surface of the water (Hayes and Miyamoto 1984). Egg masses contain approximately 2000 to 6000 eggs ranging in size between 2 and 2.8 mm (Jennings and Hayes 1994). Embryos hatch 10 to 14 days after fertilization (Fellers 2005a) depending on water temperature. Egg predation is reported to be infrequent and most mortality is associated with the larval stage (particularly through predation by fish); however, predation on eggs by newts has also been reported (Rathburn 1998). Tadpoles require 11 to 28 weeks to metamorphose into juveniles (terrestrial-phase), typically between May and September (Jennings and Hayes 1994, USFWS 2002); tadpoles have been observed to over-winter (delay metamorphosis until the following year) (Fellers 2005b, USFWS 2002). Males reach sexual maturity at 2 years, and females reach sexual maturity at 3 years of age; adults have been reported to live 8 to 10 years (USFWS 2002). **Figure 6** depicts CRLF annual reproductive timing.

Figure 6. CRLF Reproductive Events by Month

J	F	M	A	M	J	J	A	S	O	N	D

Light Blue = Breeding/Egg Masses
 Green = Tadpoles (except those that over-winter)
 Orange = Young Juveniles
 Adults and juveniles can be present all year

2.5.3 Diet

Although the diet of CRLF aquatic-phase larvae (tadpoles) has not been studied specifically, it is assumed that their diet is similar to that of other frog species, with the aquatic phase feeding exclusively in water and consuming diatoms, algae, and detritus (USFWS 2002). Tadpoles filter and entrap suspended algae (Seale and Beckvar, 1980)

via mouthparts designed for effective grazing of periphyton (Wassersug, 1984, Kupferberg *et al.*; 1994; Kupferberg, 1997; Altig and McDiarmid, 1999).

Juvenile and adult CRLFs forage in aquatic and terrestrial habitats, and their diet differs greatly from that of larvae. The main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic and terrestrial invertebrates found along the shoreline and on the water surface. Hayes and Tennant (1985) report, based on a study examining the gut content of 35 juvenile and adult CRLFs, that the species feeds on as many as 42 different invertebrate taxa, including Arachnida, Amphipoda, Isopoda, Insecta, and Mollusca. The most commonly observed prey species were larval alderflies (*Sialis cf. californica*), pillbugs (*Armadillidium vulgare*), and water striders (*Gerris* sp). The preferred prey species, however, was the sowbug (Hayes and Tennant, 1985). This study suggests that CRLFs forage primarily above water, although the authors note other data reporting that adults also feed under water, are cannibalistic, and consume fish. For larger CRLFs, over 50% of the prey mass may consist of vertebrates such as mice, frogs, and fish, although aquatic and terrestrial invertebrates were the most numerous food items (Hayes and Tennant 1985). For adults, feeding activity takes place primarily at night; for juveniles feeding occurs during the day and at night (Hayes and Tennant 1985).

2.5.4 Habitat

CRLFs require aquatic habitat for breeding, but also use other habitat types including riparian and upland areas throughout their life cycle. CRLF use of their environment varies; they may complete their entire life cycle in a particular habitat or they may utilize multiple habitat types. Overall, populations are most likely to exist where multiple breeding areas are embedded within varying habitats used for dispersal (USFWS 2002). Generally, CRLFs utilize habitat with perennial or near-perennial water (Jennings *et al.* 1997). Dense vegetation close to water, shading, and water of moderate depth are habitat features that appear especially important for CRLF (Hayes and Jennings 1988). Breeding sites include streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds (land depressions between fault zones that have filled with water), dune ponds, and lagoons. Breeding adults have been found near deep (0.7 m) still or slow moving water surrounded by dense vegetation (USFWS 2002); however, the largest number of tadpoles have been found in shallower pools (0.26 – 0.5 m) (Reis, 1999). Data indicate that CRLFs do not frequently inhabit vernal pools, as conditions in these habitats generally are not suitable (Hayes and Jennings 1988).

CRLFs also frequently breed in artificial impoundments such as stock ponds, although additional research is needed to identify habitat requirements within artificial ponds (USFWS 2002). Adult CRLFs use dense, shrubby, or emergent vegetation closely associated with deep-water pools bordered with cattails and dense stands of overhanging vegetation (http://www.fws.gov/endangered/features/rl_frog/rlfrog.html#where).

In general, dispersal and habitat use depends on climatic conditions, habitat suitability, and life stage. Adults rely on riparian vegetation for resting, feeding, and dispersal. The foraging quality of the riparian habitat depends on moisture, composition of the plant

community, and presence of pools and backwater aquatic areas for breeding. CRLFs can be found living within streams at distances up to 3 km (2 miles) from their breeding site and have been found up to 30 m (100 feet) from water in dense riparian vegetation for up to 77 days (USFWS 2002).

During dry periods, the CRLF is rarely found far from water, although it will sometimes disperse from its breeding habitat to forage and seek other suitable habitat under downed trees or logs, industrial debris, and agricultural features (USFWS 2002). According to Jennings and Hayes (1994), CRLFs also use small mammal burrows and moist leaf litter as habitat. In addition, CRLFs may also use large cracks in the bottom of dried ponds as refugia; these cracks may provide moisture for individuals avoiding predation and solar exposure (Alvarez 2000).

2.6 Designated Critical Habitat

In a final rule published on April 13, 2006, 34 separate units of critical habitat were designated for the CRLF by USFWS (USFWS 2006; FR 51 19244-19346). A summary of the 34 critical habitat units relative to USFWS-designated recovery units and core areas (previously discussed in Section 2.5.1) is provided in **Table 2.08**.

‘Critical habitat’ is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are ‘essential to the conservation of the species.’ All designated critical habitat for the CRLF was occupied at the time of listing. Critical habitat receives protection under Section 7 of the ESA through prohibition against destruction or adverse modification with regard to actions carried out, funded, or authorized by a federal Agency. Section 7 requires consultation on federal actions that are likely to result in the destruction or adverse modification of critical habitat.

To be included in a critical habitat designation, the habitat must be ‘essential to the conservation of the species.’ Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). PCEs include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. The designated critical habitat areas for the CRLF are considered to have the following PCEs that justify critical habitat designation:

- Breeding aquatic habitat;
- Non-breeding aquatic habitat;
- Upland habitat; and

- Dispersal habitat.

Further description of these habitat types is provided in Attachment 1.

Occupied habitat may be included in the critical habitat only if essential features within the habitat may require special management or protection. Therefore, USFWS does not include areas where existing management is sufficient to conserve the species. Critical habitat is designated outside the geographic area presently occupied by the species only when a designation limited to its present range would be inadequate to ensure the conservation of the species. For the CRLF, all designated critical habitat units contain all four of the PCEs, and were occupied by the CRLF at the time of FR listing notice in April 2006. The FR notice designating critical habitat for the CRLF includes a special rule exempting routine ranching activities associated with livestock ranching from incidental take prohibitions. The purpose of this exemption is to promote the conservation of rangelands, which could be beneficial to the CRLF, and to reduce the rate of conversion to other land uses that are incompatible with CRLF conservation. Please see Attachment 1 for a full explanation on this special rule.

USFWS has established adverse modification standards for designated critical habitat (USFWS 2006). Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of captan that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. According to USFWS (2006), activities that may affect critical habitat and therefore result in adverse effects to the CRLF include, but are not limited to the following:

- (1) Significant alteration of water chemistry or temperature to levels beyond the tolerances of the CRLF that result in direct or cumulative adverse effects to individuals and their life-cycles.
- (2) Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat that could result in elimination or reduction of habitat necessary for the growth and reproduction of the CRLF by increasing the sediment deposition to levels that would adversely affect their ability to complete their life cycles.
- (3) Significant alteration of channel/pond morphology or geometry that may lead to changes to the hydrologic functioning of the stream or pond and alter the timing, duration, water flows, and levels that would degrade or eliminate the CRLF and/or its habitat. Such an effect could also lead to increased sedimentation and degradation in water quality to levels that are beyond the CRLF's tolerances.
- (4) Elimination of upland foraging and/or aestivating habitat or dispersal habitat.
- (5) Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
- (6) Alteration or elimination of the CRLF's food sources or prey base (also evaluated as indirect effects to the CRLF).

As previously noted in Section 2.1, the Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because captan is expected to directly impact living organisms within the action area, critical habitat analysis for captan is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes.

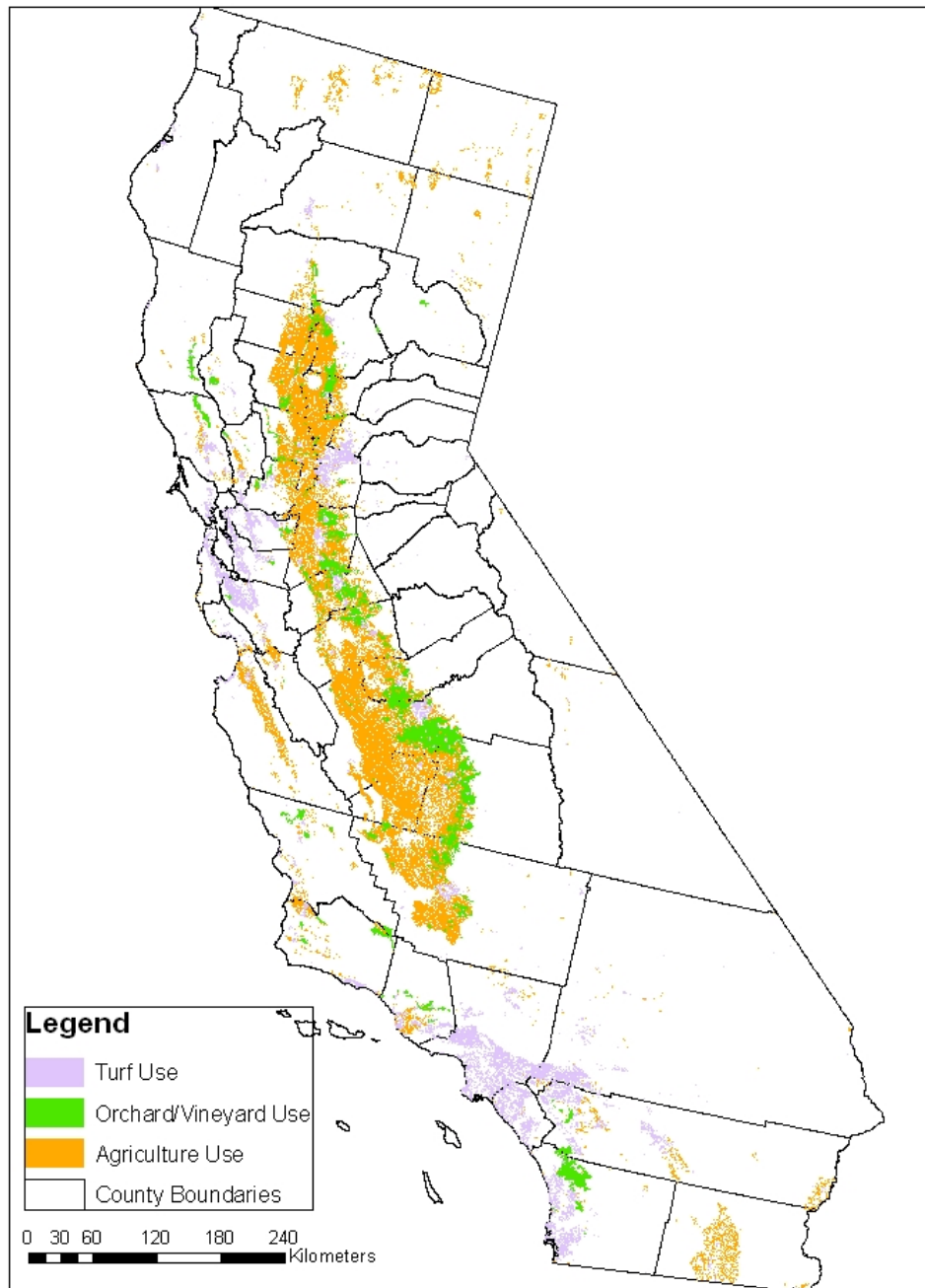
2.7 Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). It is recognized that the overall action area for the national registration of captan is likely to encompass considerable portions of the United States based on the large array of agricultural and non-agricultural uses. However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the CRLF and its designated critical habitat within the state of California. Deriving the geographical extent of this portion of the action area is the product of consideration of the types of effects that captan may be expected to have on the environment, the exposure levels to captan that are associated with those effects, and the best available information concerning the use of captan and its fate and transport within the state of California.

The definition of action area requires a stepwise approach that begins with an understanding of the federal action. The federal action is defined by the currently labeled uses for captan. An analysis of labeled uses and review of available product labels was completed. Foliar and seed applications of captan to the food and non-food uses listed in **Table 2.01** were assessed.

After a determination of which uses will be assessed, an evaluation of the potential “footprint” of the use pattern should be determined. This “footprint” represents the initial area of concern and is typically based on available land cover data for the state of California. The use map shows the extent of orchard/vineyard, agricultural (including ornamentals), and turf land cover which represent the labeled uses for captan in California (**Figure 7**). The initial area of concern is defined as the agriculture, turf and orchard/vineyard land cover types and the initial stream reaches (**Figure 8**).

Captan Use Map



Compiled from California County boundaries (ESRI, 2002),
 USDA National Agriculture Statistical Service (NASS, 2002)
 Gap Analysis Program Orchard/Vineyard Landcover (GAP)
 National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office
 of Pesticides Programs, Environmental Fate and Effects Division.
 September, 2007. Projection: Albers Equal Area Conic USGS,
 North American Datum of 1983 (NAD 1983)

Figure 7. Land cover map of captan uses in orchard/ vineyard, agricultural (including ornamentals), and turf areas in California

Captan - Initial Area of Concern

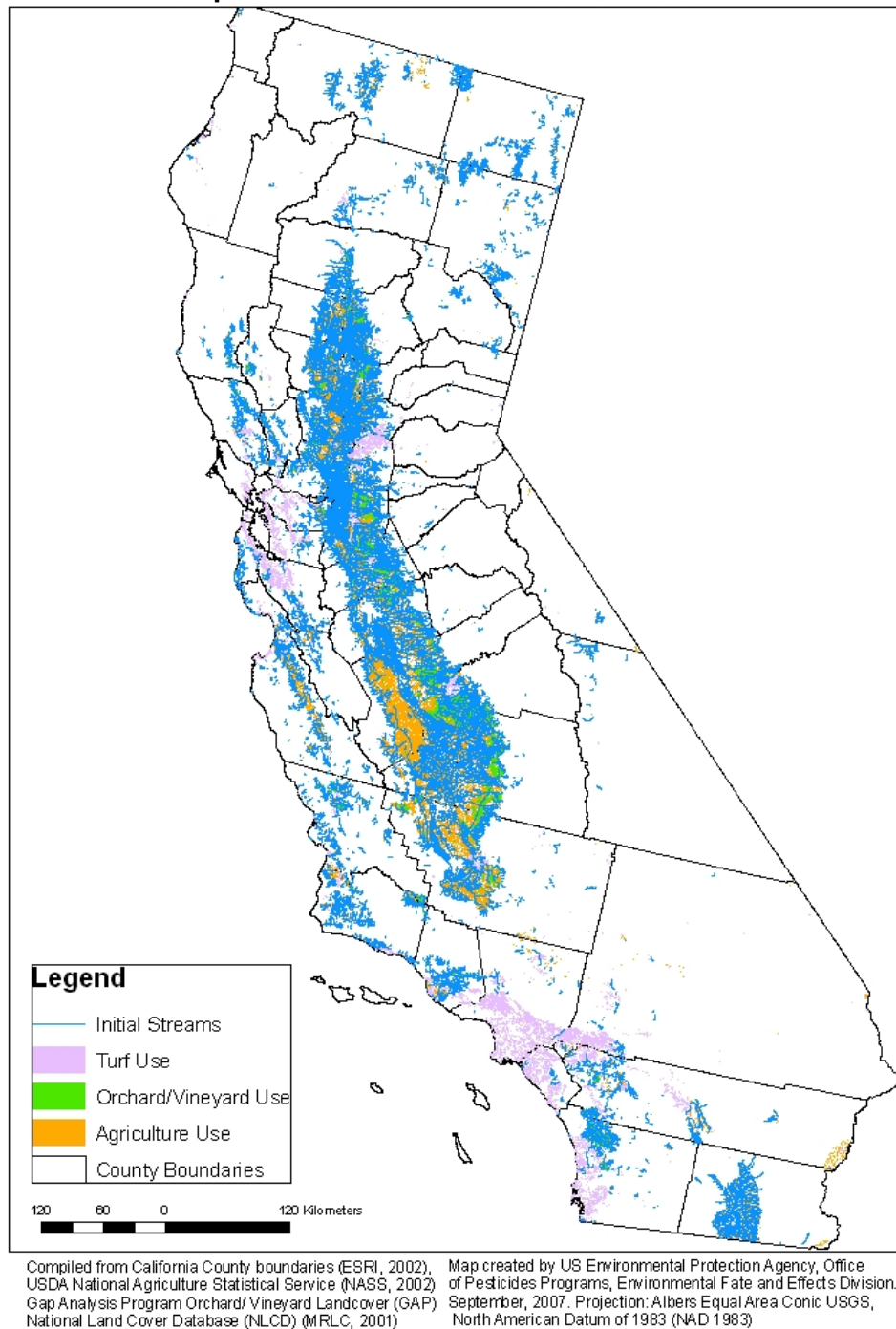


Figure 8. Land cover map of captan initial area of concern including the orchard/vineyard, agricultural (including ornamentals), and turf areas and initial stream reaches in California.

Once the initial area of concern is defined, the next step is to compare the extent of that area with the results of the screening level risk assessment. The screening level risk assessment will define which taxa, if any, are predicted to be exposed at concentrations above the Agency's Levels of Concern (LOC). The screening level assessment includes an evaluation of the environmental fate properties of captan to determine which routes of transport are likely to have an impact on the CRLF.

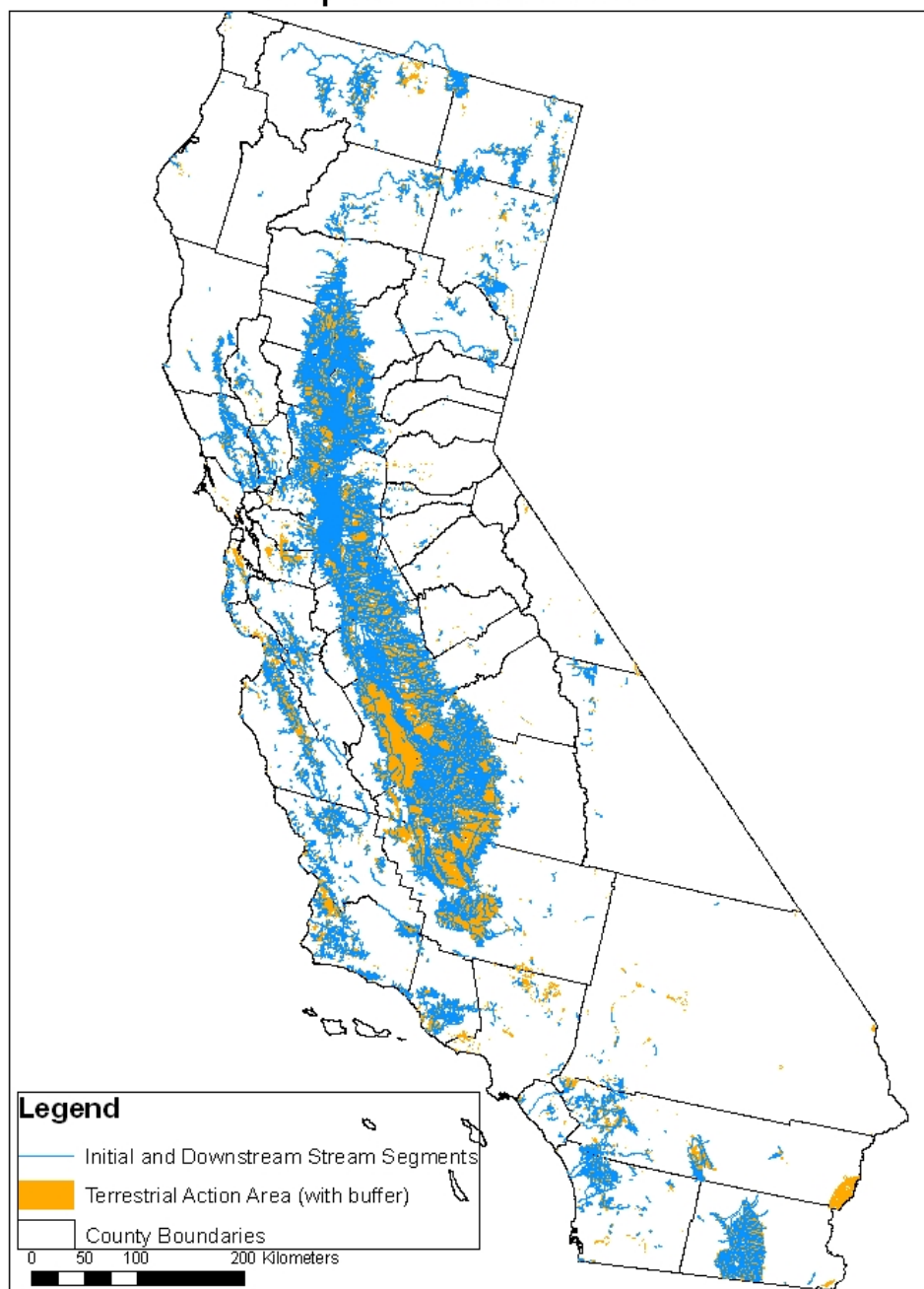
LOC exceedances are used to describe how far effects may be seen from the initial area of concern. Factors considered include: spray drift and downstream run-off. This information is incorporated into GIS and a map of the action area is created.

The AgDRIFT model (Version 2.01) is used to define how far from the initial area of concern an effect to a given terrestrial species may be expected. The spray drift analysis for captan using the most sensitive terrestrial toxicity endpoint (*i.e.*, terrestrial invertebrates) suggests that the distance for potential effects from the treated area of concern is not within the range of the AgDrift model (*i.e.*, 1000 feet). Subsequently, the AgDISP model (Version 8.15) with the Gaussian extension (used for longer range transport because the limits of the regular AgDISP model were exceeded) was used to define this distance. The AgDISP model was run in ground mode using default settings (except for wind speed at 10 mph and release height at 4 feet). Using the Gaussian extension, a maximum spray drift distance of 8,740 feet was derived. Further detail on the spray drift analysis is provided in Section 3.2.3. Further detail on defining the terrestrial action area is provided in Section 5.1.4.2.

In addition to the buffered area from the spray drift analysis, the final action area also considers the downstream extent of captan that exceeds the LOC (discussed in Section 3.2.4). The downstream area of the action area for captan is based on the endangered species LOCs for freshwater fish. Further detail on defining the aquatic action area is provided in Section 5.1.4.1. The action area for captan, including the full extent (based on the listed species LOCs) and the portion of the action area that is relevant for the CRLF is presented graphically in **Figure 9**. Further detail on defining the final action area is provided in Section 5.1.4.3.

Subsequent to defining the action area, an evaluation of usage information was conducted to determine the area where use of captan may impact the CRLF. This analysis is used to characterize where predicted exposures are most likely to occur, but does not preclude use in other portions of the action area. Usage data suggests that areas of the largest captan usage in California, such as use on strawberries in Monterey, overlap with counties having the greatest numbers of the CRLF. The greatest numbers of the CRLF occur in Monterey, San Luis Obispo, and Santa Barbara counties (USFWS, 1996) in California.

Captan - Action Area



Compiled from California County boundaries (ESRI, 2002),
 USDA National Agriculture Statistical Service (NASS, 2002)
 Gap Analysis Program Orchard/Vineyard Landcover (GAP)
 National Land Cover Database (NLCD) (MRLC, 2001)

Map created by US Environmental Protection Agency, Office
 of Pesticides Programs, Environmental Fate and Effects Division.
 September, 2007. Projection: Albers Equal Area Conic USGS,
 North American Datum of 1983 (NAD 1983)

Figure 9. Action area map for captan including terrestrial action area (agriculture, turf, and orchard/vineyard land uses with buffer) and aquatic action area (downstream extent)

2.8 Assessment Endpoints and Measures of Ecological Effect

Assessment endpoints are defined as “explicit expressions of the actual environmental value that is to be protected.”⁵ Selection of the assessment endpoints is based on valued entities (e.g., CRLF, organisms important in the life cycle of the CRLF, and the PCEs of its designated critical habitat), the ecosystems potentially at risk (e.g., waterbodies, riparian vegetation, and upland and dispersal habitats), the migration pathways of captan (e.g., runoff, spray drift, etc.), and the routes by which ecological receptors are exposed to captan-related contamination (e.g., direct contact, etc).

2.8.1 Assessment Endpoints for the CRLF

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of the prey base and/or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF. Each assessment endpoint requires one or more “measures of ecological effect,” defined as changes in the attributes of an assessment endpoint or changes in a surrogate entity or attribute in response to exposure to a pesticide. Specific measures of ecological effect are generally evaluated based on acute and chronic toxicity information from registrant-submitted guideline tests that are performed on a limited number of organisms. Additional ecological effects data from the open literature are also considered.

A complete discussion of all the toxicity data available for this risk assessment, including resulting measures of ecological effect selected for each taxonomic group of concern, is included in Section 4 of this document. A summary of the assessment endpoints and measures of ecological effect selected to characterize potential assessed direct and indirect CRLF risks associated with exposure to captan is provided in **Table 2.09**.

Table 2.09. Summary of Assessment Endpoints and Measures of Ecological Effects for Direct and Indirect Effects of Captan on the California Red-legged Frog	
Assessment Endpoint	Measures of Ecological Effects⁶
<i>Aquatic Phase</i> (eggs, larvae, tadpoles, juveniles, and adults) ^a	
1. Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	1a. Brown Trout acute LC ₅₀ 1c. Fathead Minnow chronic NOAEC
2. Survival, growth, and reproduction of CRLF individuals via effects to food supply (<i>i.e.</i> , freshwater invertebrates, non-vascular plants)	2a. Brown Trout acute LC ₅₀ 2b. Fathead minnow chronic NOAEC 2c. Water flea acute EC ₅₀ 2d. Water flea chronic NOAEC 2e. Non-vascular plant (freshwater algae) acute EC ₅₀
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover,	3a. Vascular plant acute EC ₅₀ (duckweed) 3b. Non-vascular plant acute EC ₅₀ (freshwater

⁵ From U.S. EPA (1992). *Framework for Ecological Risk Assessment*. EPA/630/R-92/001.

⁶ All registrant-submitted and open literature toxicity data reviewed for this assessment are included in Appendix A.

and/or primary productivity (<i>i.e.</i> , aquatic plant community)	algae)
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	4a. Terrestrial Plants (qualitative data) 4b. Terrestrial Plants (qualitative data) ⁷
<i>Terrestrial Phase (Juveniles and adults)</i>	
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Mallard Duck acute LD ₅₀ ^b 5b. Mallard Duck/ Northern bobwhite quail chronic NOAEC ^b
6. Survival, growth, and reproduction of CRLF individuals via effects on prey (<i>i.e.</i> , terrestrial invertebrates, small terrestrial vertebrates, including mammals and terrestrial phase amphibians)	6a. Honey bee acute contact LD ₅₀ 6b. Rat acute LD ₅₀ 6b. Rat chronic NOAEC 6b. Mallard duck acute LD ₅₀ ^b 6b. Bobwhite quail chronic NOAEC ^b
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (<i>i.e.</i> , riparian vegetation)	7a. Terrestrial Plants (qualitative data) 7b. Terrestrial Plants (qualitative data)
^a Adult frogs are no longer in the "aquatic phase" of the amphibian life cycle; however, submerged adult frogs are considered "aquatic" for the purposes of this assessment because exposure pathways in the water are considerably different than exposure pathways on land. ^b Birds are used as surrogates for terrestrial phase amphibians. ^c Although the most sensitive toxicity value is initially used to evaluate potential indirect effects, sensitivity distribution is used (if sufficient data are available) to evaluate the potential impact to food items of the CRLF.	

2.8.2 Assessment Endpoints for Designated Critical Habitat

As previously discussed, designated critical habitat is assessed to evaluate actions related to the use of captan that may alter the PCEs of the CRLF's critical habitat. PCEs for the CRLF were previously described in Section 2.6. Actions that may modify critical habitat are those that alter the PCEs. Therefore, these actions are identified as assessment endpoints. It should be noted that evaluation of PCEs as assessment endpoints is limited to those of a biological nature (*i.e.*, the biological resource requirements for the listed species associated with the critical habitat) and those for which captan effects data are available.

Modification to the critical habitat of the CRLF includes the following, as specified by USFWS (2006) and previously discussed in Section 2.6:

1. Alteration of water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs.
2. Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

⁷ The available information indicates that the California red-legged frog does not have any obligate relationships.

3. Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat.
4. Significant alteration of channel/pond morphology or geometry.
5. Elimination of upland foraging and/or aestivating habitat, as well as dispersal habitat.
6. Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
7. Alteration or elimination of the CRLF's food sources or prey base.

Measures of such possible effects by labeled use of captan on critical habitat of the CRLF are described in **Table 2.10**. Some components of these PCEs are associated with physical abiotic features (e.g., presence and/or depth of a water body, or distance between two sites), which are not expected to be measurably altered by use of pesticides. Assessment endpoints used for the analysis of designated critical habitat are based on the adverse modification standard established by USFWS (2006).

Table 2.10. Summary of Assessment Endpoints and Measures of Ecological Effect for Primary Constituent Elements of Designated Critical Habitat

Assessment Endpoint	Measures of Ecological Effect ⁸
<i>Aquatic Phase PCEs</i> (<i>Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat</i>)	
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	a. Aquatic non-vascular plant EC ₅₀ b. Terrestrial Plants (qualitative data) c. Terrestrial Plants (qualitative data)
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source. ⁹	a. Aquatic non-vascular plant EC ₅₀ b. Terrestrial Plants (qualitative data) c. Terrestrial Plants (qualitative data)
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	a. Brown Trout LC ₅₀ b. Fathead minnow chronic NOAEC c. Water flea acute EC ₅₀ d. Water flea chronic NOAEC e. Non-vascular plant (freshwater algae) acute EC ₅₀
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	a. Aquatic non-vascular plant EC ₅₀
<i>Terrestrial Phase PCEs</i> (<i>Upland Habitat and Dispersal Habitat</i>)	
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	a. Terrestrial Plants (qualitative data) b. Terrestrial Plants (qualitative data) c. Honey bee oral LD ₅₀ d. Rat acute LD ₅₀ e. Rat chronic NOAEC f. Mallard duck acute LD ₅₀ g. Mallard duck/ Bobwhite quail chronic NOAEC
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	

⁸ All toxicity data reviewed for this assessment are included in Appendix A.

⁹ Physico-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

2.9 Conceptual Model

2.9.1 Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (i.e., changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (U.S. EPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of captan to the environment. The following risk hypotheses are presumed for this endangered species assessment:

- Labeled uses of captan within the action area may directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- Labeled uses of captan within the action area may indirectly affect the CRLF by reducing or changing the composition of food supply;
- Labeled uses of captan within the action area may indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the aquatic plant community in the ponds and streams comprising the species' current range and designated critical habitat, thus affecting primary productivity and/or cover;
- Labeled uses of captan within the action area may indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the terrestrial plant community (i.e., riparian habitat) required to maintain acceptable water quality and habitat in the ponds and streams comprising the species' current range and designated critical habitat;
- Labeled uses of captan within the action area may modify the designated critical habitat of the CRLF by reducing or changing breeding and non-breeding aquatic habitat (via modification of water quality parameters, habitat morphology, and/or sedimentation);
- Labeled uses of captan within the action area may modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- Labeled uses of captan within the action area may modify the designated critical habitat of the CRLF by reducing or changing upland habitat within 200 ft of the edge of the riparian vegetation necessary for shelter, foraging, and predator avoidance.
- Labeled uses of captan within the action area may modify the designated critical habitat of the CRLF by reducing or changing dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.
- Labeled uses of captan within the action area may modify the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

2.9.2 Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the stressor (captan), release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual models for aquatic and terrestrial phases of the CRLF are shown in **Figures 10 and 11**, and the conceptual models for the aquatic and terrestrial PCE components of critical habitat are shown in **Figures 12 and 13**. Exposure routes shown in dashed lines are not quantitatively considered because the resulting exposures are expected to be so low as not to cause adverse effects to the CRLF and modification to designated critical habitat is expected to be negligible.

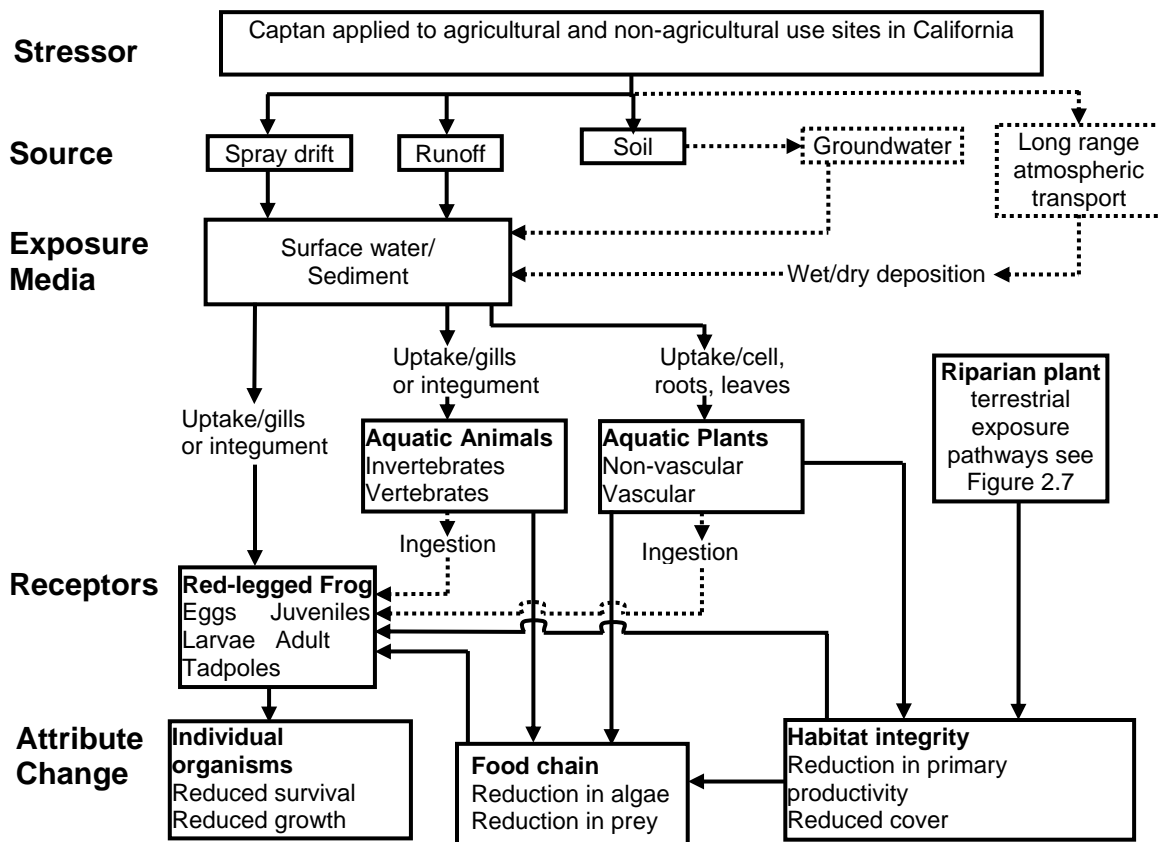


Figure 10. Conceptual Model for Pesticide Effects on Aquatic Phase of the Red-Legged Frog

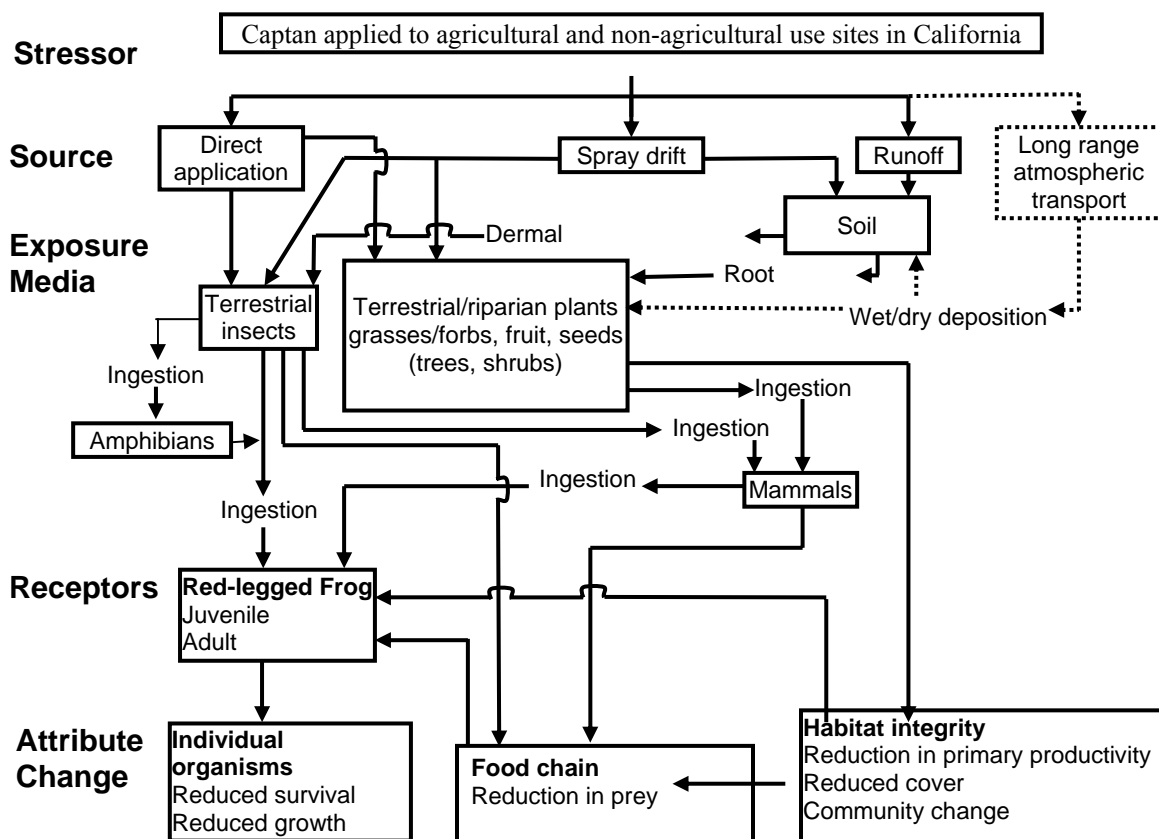


Figure 11. Conceptual Model for Pesticide Effects on Terrestrial Phase of Red-Legged Frog

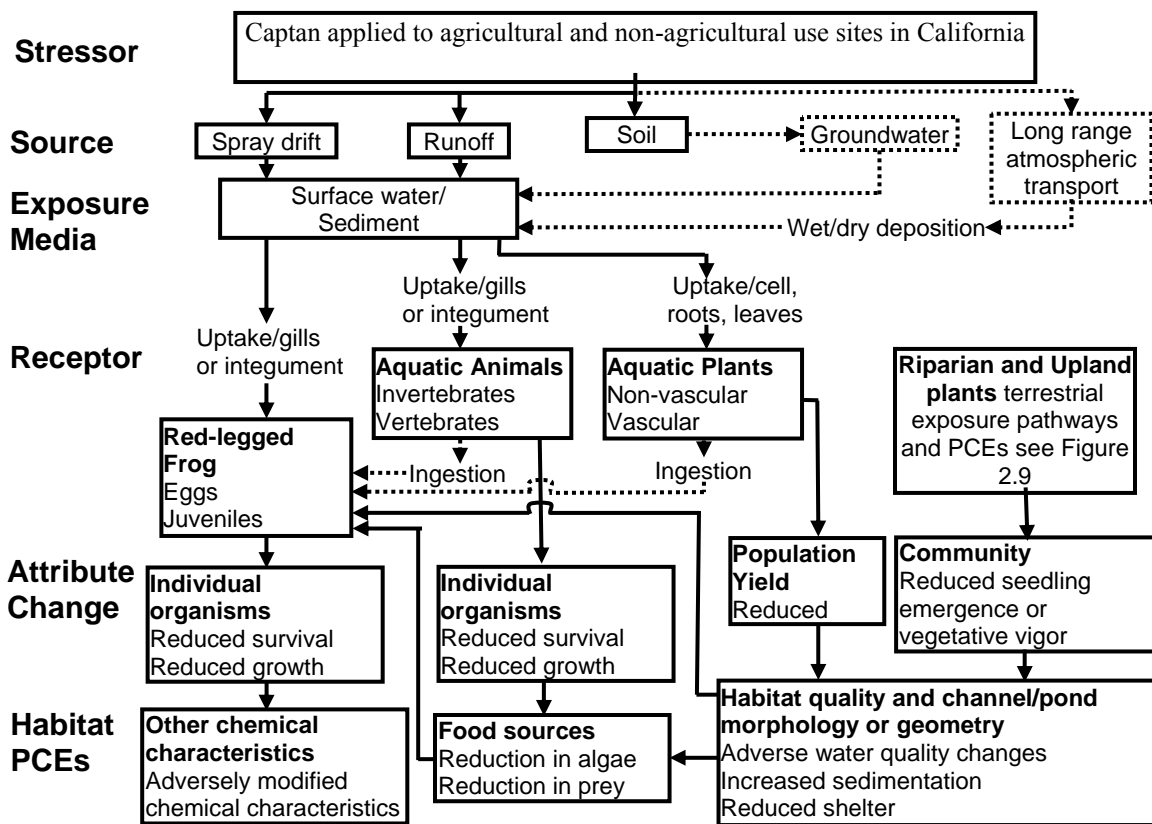


Figure 12. Conceptual Model for Pesticide Effects on Aquatic Components of Red-Legged Frog Critical Habitat

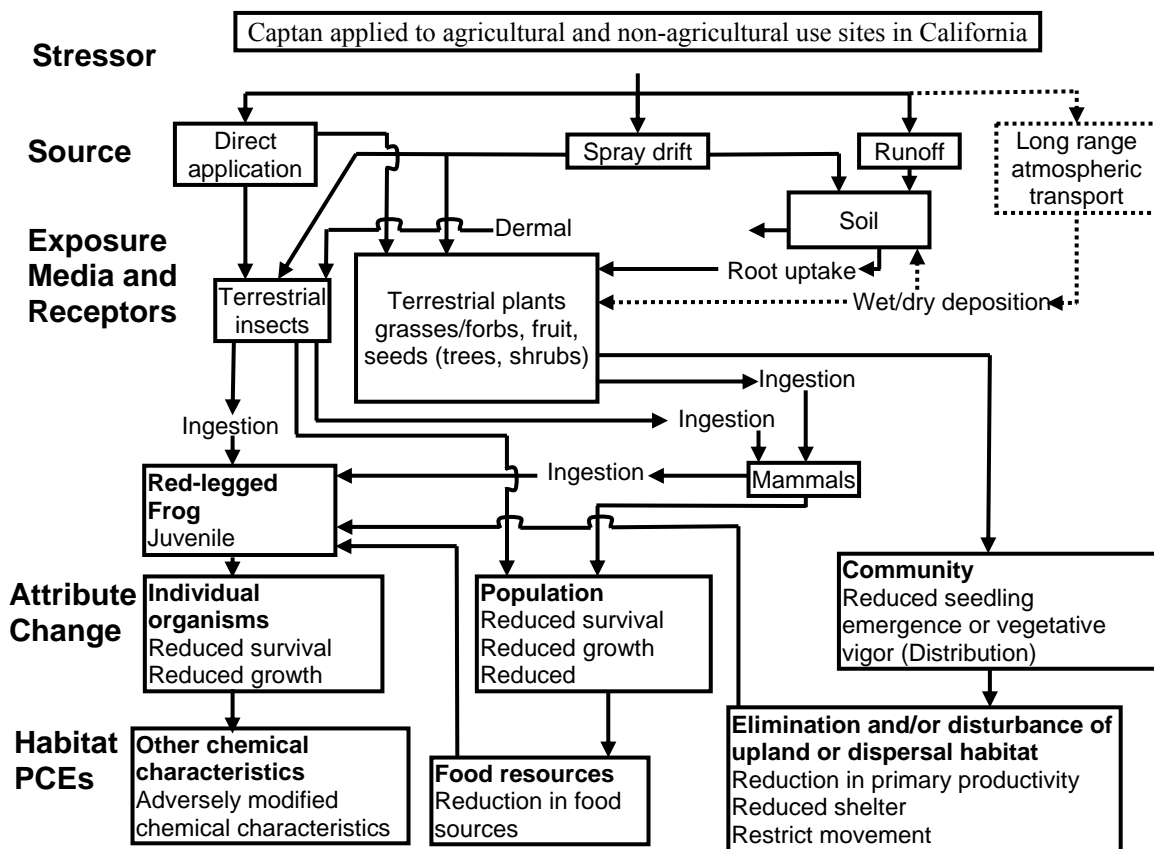


Figure 13. Conceptual Model for Pesticide Effects on Terrestrial Components of Red-Legged Frog Critical Habitat

2.10 Analysis Plan

In order to address the risk hypothesis, the potential for direct and indirect effects to the CRLF, its prey, and its habitat is estimated. In the following sections, the use, environmental fate, and ecological effects of captan are characterized and integrated to assess the risks. This is accomplished using a risk quotient (ratio of exposure concentration to effects concentration) approach. Although risk is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. However, as outlined in the Overview Document (U.S. EPA, 2004), the likelihood of effects to individual organisms from particular uses of captan is estimated using the probit dose-response slope and either the level of concern (discussed below) or actual calculated risk quotient value.

2.10.1 Measures to Evaluate the Risk Hypothesis and Conceptual Model

2.10.1.1 Measures of Exposure

The environmental fate properties of captan indicate that runoff and spray drift are the principle potential transport mechanisms of captan to the aquatic and terrestrial habitats

of the CRLF. In this assessment, transport of captan through runoff and spray drift is considered in deriving quantitative estimates of captan exposure to CRLF, its prey and its habitats. Captan has low potential for volatility and measured concentrations were below the level of detection in air monitoring samples, therefore long range transport is unlikely. Deposition of captan was estimated from local spray drift on terrestrial habitats that neighbor application sites.

Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of captan using maximum labeled application rates and methods. The models used to predict aquatic EECs are the Pesticide Root Zone Model coupled with the Exposure Analysis Model System (PRZM/EXAMS). The model used to predict terrestrial EECs on food items is T-REX. The THERPS model was used to refine terrestrial dose-based EECs by including amphibian/reptile specific allometric equations. The model used to derive EECs relevant to terrestrial and wetland plants is TerrPlant. These models are parameterized using relevant reviewed registrant-submitted environmental fate data.

PRZM (v3.12beta, May 24, 2001) and EXAMS (v2.98.04, Aug. 18, 2002) are screening simulation models coupled with the input shell pe4v01.pl (Aug. 8, 2003) to generate daily exposures and 1-in-10 year EECs of captan that may occur in surface water bodies adjacent to application sites receiving captan through runoff and spray drift. PRZM simulates pesticide application, movement and transformation on an agricultural field and the resultant pesticide loadings to a receiving water body via runoff, erosion and spray drift. EXAMS simulates the fate of the pesticide and resulting concentrations in the water body. The standard scenario used for ecological pesticide assessments assumes application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body that is 2 meters deep (20,000 m³ volume) with no outlet. PRZM/EXAMS is used to estimate screening-level exposure of aquatic organisms to captan. The measure of exposure for aquatic species is the 1-in-10 year return peak or rolling mean concentration. The 1-in-10 year peak is used for estimating acute exposures of direct effects to the CRLF, as well as indirect effects to the CRLF through effects to potential prey items, including: algae, aquatic invertebrates, fish, and frogs. The 1-in-10-year 60-day mean is used for assessing chronic exposure to the CRLF and fish and frogs serving as prey items. The 1-in-10-year 21-day mean is used for assessing aquatic invertebrate chronic exposure, which are also potential prey items.

Exposure estimates for the terrestrial-phase CRLF and terrestrial invertebrates and mammals (serving as potential prey) assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.3.1, 12/07/2006). This model incorporates the Kenega nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper limit values from the nomograph represented the 95th percentile of residue values from actual field measurements (Hoerger and Kenega, 1972). The Fletcher *et al.* (1994) modifications to the Kenega nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. These modifications represent the 95th percentile of the expanded data set. For

modeling purposes, direct exposures of the CRLF to captan through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey (small mammals) are assessed using the small mammal (15 g) which consumes short grass. The small bird (20g) consuming small insects and the small mammal (15g) consuming short grass are used because these categories represent the largest RQs of the size and dietary categories in T-REX that are appropriate surrogates for the CRLF and one of its prey items. Estimated exposures of terrestrial insects to captan are bound by using the dietary based EECs for small insects and large insects.

Spray drift models, AGDISP is used to assess exposures of terrestrial phase CRLF and its prey to captan deposited on terrestrial habitats by spray drift. AGDISP (version 8.13; dated 12/14/2004) (Teske and Curbishley, 2003) is used to simulate aerial and ground applications using the Gaussian farfield extension.

2.10.1.2 Measures of Effect

Data identified in Section 2.8 are used as measures of effect for direct and indirect effects to the CRLF. Data were obtained from registrant submitted studies or from literature studies identified by ECOTOX. The ECOTOXicology database (ECOTOX) was searched in order to provide more ecological effects data and in an attempt to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by the USEPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division.

The assessment of risk for direct effects to the terrestrial-phase CRLF makes the assumption that toxicity of captan to birds is similar to the terrestrial-phase CRLF. The same assumption is made for fish and aquatic-phase CRLF. Algae, aquatic invertebrates, fish, and amphibians represent potential prey of the CRLF in the aquatic habitat. Terrestrial invertebrates, small mammals, and terrestrial-phase amphibians represent potential prey of the CRLF in the terrestrial habitat. Aquatic, semi-aquatic, and terrestrial plants represent habitat of CRLF.

The acute measures of effect used for animals in this screening level assessment are the LD₅₀, LC₅₀ and EC₅₀. LD stands for "Lethal Dose", and LD₅₀ is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for "Lethal Concentration" and LC₅₀ is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for "Effective Concentration" and the EC₅₀ is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for "No Observed-Adverse-Effect-Level" and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration at which none of the observed effects were statistically different from the control. The

NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (*i.e.*, EC₂₅ for terrestrial plants and EC₅₀ for aquatic plants).

2.10.1.3 Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from agricultural and non-agricultural uses of captan, and the likelihood of direct and indirect effects to CRLF in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. For the assessment of captan risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's levels of concern (LOCs) (USEPA, 2004) (see Appendix D).

For this endangered species assessment, listed species LOCs are used for comparing RQ values for acute and chronic exposures of captan directly to the CRLF. If estimated exposures directly to the CRLF of captan resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is "may affect." When considering indirect effects to the CRLF due to effects to animal prey (aquatic and terrestrial invertebrates, fish, frogs, and mice), the listed species LOCs are also used. If estimated exposures to CRLF prey of captan resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is a "may affect." If the RQ being considered also exceeds the non-listed species LOC, then the effects determination is a LAA. If the RQ is between the listed species LOC and the non-listed species LOC, then further lines of evidence (*i.e.* probability of individual effects, species sensitivity distributions) are considered in distinguishing between a determination of NLAA and a LAA. When considering indirect effects to the CRLF due to effects to algae as dietary items or plants as habitat, the non-listed species LOC for plants is used because the CRLF does not have an obligate relationship with any particular aquatic and/or terrestrial plant. If the RQ being considered for a particular use exceeds the non-listed species LOC for plants, the effects determination is "may affect."

3. Exposure Assessment

3.1 Label Application Rates and Intervals

Captan is used as both a foliar treatment and a seed treatment for food and non-food uses. The pesticide has several formulations and is applied by various methods, including aerial, airblast, dust and groundboom. It used as a foliar spray on almond, strawberry, ginseng, and several orchard and vineyard crops. The EECs based on the foliar spray food uses and seed treatment uses were modeled using the appropriate PRZM-EXAMS scenarios (**Table 3.01**). Seed treatment application rates are found in **Table 2.06**.

Captan use on berries (blueberries, caneberries, raspberries, blackberry, dewberry, and loganberry) was modeled using the CA wine grape scenario. According to NASS,

blueberries are grown in the coastal valley. The CA wine grape scenario represents a field in Northern coastal CA (Sonoma, Napa, Lake, and Mendocino Counties). The meteorological station for this scenario is located in San Francisco. The meteorological station and the soil for the CA wine grape scenario overlap in range with the region of blueberry cultivation. The range of the other berries in California is similar to blueberries. However, captan use on grapes was modeled using the CA standard grape scenario which represents a wide range of area and represents all grape-growing areas in California.

Captan is used on golf course turf, turf sod farms, and dichondra grasses as a foliar application. The maximum application rate for turf is 4.3 lb a.i./A with 2 applications at a 7-day interval. Ornamental grasses in non-pasture areas are also treated for several diseases and can be sprayed beginning at spring and applied throughout the season. The maximum single application rate for ornamental grasses is also 4.3 lb a.i./A. The maximum annual application rate and number of applications were not specified on the Drexel Chemical Company labels, therefore it was estimated for this assessment that the season would last approximately seven months and result in a maximum of 26 applications with 7-day intervals. These Drexel Chemical Company labels include EPA Reg. 019713-00156, 019713-00235, 019713-00362, 019713-00385, and 019713-00405. These uses were modeled using the California turf PRZM EXAMS scenario (**Table 3.02**).

Captan can be used to treat lawn seedbeds and preplant seedlings or transplants of roses or other shrubs, trees, and flowers at 6.53 lb a.i./A with incorporation in the top 3-4 inches of soil before planting. Captan is also used as a preplant dip for flowers (azaleas, begonias, carnations, chrysanthemum, and gladiolus). Captan can be used to treat damping-off and corm rot for azaleas, begonias, chrysanthemum, and gladiolus by dipping the cuttings, tubers, or corms before bedding or planting at rates of 2 lb a.i./ 100 gallon to 0.75 lb a.i./ 10 gallons. The uses were not modeled in this assessment because exposure is expected to be negligible from dip and preplant treatment as compared to the other modeled ornamentals uses applied by aerial and ground application.

Azaleas and camellias can also be treated with captan for petal blight by spraying the flowers and/ or the soil through bloom at rates of 0.5 to 1.0 lb a.i./A. Bloom can be up to 5 weeks for azaleas and 3 months for camellias according to Cheryl Wilen at University of California at Davis (personal communication). Carnations, chrysanthemum and roses are treated for several diseases and the flowers can be sprayed at the first sign of disease and applied as needed. A crop cycle for chrysanthemum is 7-10 weeks before blooming. So if they have leaf diseases, they would need to apply during that period. Application to roses is to occur at first sign of disease at a rate of 1 lb a.i./A and could occur year-round in California. Foliar application to these flowers was not assessed because environmental exposure is expected to be lower than the ornamental grass and turf uses. In addition, many of these flowers are treated in greenhouses or shade houses which results in minimal environmental exposure (Wilen et al, 2002).

Table 3.01. Captan Foliar Application Rates for Food Uses and modeled PRZM/EXAMS Scenarios					
SCENARIO	CROP	Max. Application Rate (lbs ai/A)	Max. # of Applications	Min. Interval Between Apps. (days)	Max. Annual Use Rate (lbs ai)
CA almond STD	ALMOND	4.5	4	7	20.00
CA potato	Ginseng	2.0	8	7	16.00
CA strawberry (non plastic) RLF	STRAWBERRY	3.0	8	7	24.00
CA fruit STD	APPLE	4.0	8	5	32.00
	APRICOT	2.5	5	5	12.50
	CHERRY	2.0	7	7	14.00
	NECTARINE	4.0	6	3	24.00
	PEACH	4.0	8	3	32.00
	PLUM/ PRUNE	3.0	9	7	27.00
CA wine grapes RLF *	BLACKBERRY	2.0	5	10	10.00
	BLUEBERRY/ CANE BERRY/ RASPBERRY	2.5	14	7	35.00
	DEWBERRY	3.13	3	10	9.39
	LOGANBERRY	1.956	5	3	9.78
CA grapes STD **	GRAPES	2.0	6	10	12.00

* The meteorological station and soil types for the CA wine grape scenario are representative of berry growing areas in Northern California

** The CA grapes standard scenario represents all grape growing areas in California

Table 3.02. Captan Foliar Application Rates for Turf/ Ornamentals and PRZM/EXAMS Scenarios				
SCENARIO	CROP	Max. Application Rate (lbs ai/A)	Max. # of Applications	Min. Interval Between Apps. (days)
CA turf RLF	Golf Course Turf, Sod Farm Turf, Dichondra grasses	4.3	2	7
	Ornamental Grasses (non-pasture areas) ¹	4.3	26	7

¹ Label (Drexel Chemical Company) does not indicate a maximum number of applications or annual rate for ornamental grasses in non-pasture areas (EPA Reg. 019713-00156, 019713-00235, 019713-00362, 019713-00385, 019713-00405).

3.2 Aquatic Exposure Assessment

For tier 2 surface-water assessments, two models are used in tandem. PRZM simulates fate and transport on the agricultural field. The version of PRZM (Carsel et al., 1998) used was PRZM 3.12 beta, dated May 24, 2001. The water body is simulated with EXAMS version 2.98, dated July 18, 2002 (Burns, 1997). Tier 2 simulations are run for multiple (usually 30) years and the reported EECs are the concentrations that are expected once every ten years based on the thirty years of daily values generated by the simulation. PRZM and EXAMS were run using the PE4 shell, dated May 14, 2003, which also summarizes the output. Input parameters are given in **Table 3.03**.

Aquatic exposures are quantitatively estimated for all of assessed uses using scenarios that represent high exposure sites for captan use. Each of these sites represents a 10 hectare field that drains into a 1-hectare pond that is 2 meters deep and has no outlet. Exposure estimates generated using the standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either shallower or have large drainage areas (or both). Shallow water bodies tend to have limited additional storage capacity, and thus, tend to overflow and carry pesticide in the discharge whereas the standard pond has no discharge. As watershed size increases beyond 10 hectares, at some point, it becomes unlikely that the entire watershed is planted to a single crop, which is all treated with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they tend to persist for only short periods of time and are then carried downstream.

Crop-specific management practices for all of the assessed uses of captan were used for modeling, including application rates, number of applications per year, application intervals, and the first application date for each crop. The date of first application was developed based on several sources of information including data provided by BEAD, a summary of individual applications from the CDPR PUR data, and Crop Profiles maintained by the USDA.

Table 3.03. PRZM/EXAM Input Parameters for Captan		
Parameter	Value and Unit	Sources
Molecular Weight	310.00 gram/mol	Product Chemistry
Henry's Law Constant	9.6E-9 Atm.M ³ Mol ⁻¹	Estimated
Vapor pressure	8 x 10 ⁻⁸ mm Hg @ 25°C	Product Chemistry
Water Solubility (pH 7, 25°C)	3.3 mg/L	Product Chemistry
Soil K _{oc}	200 mg/L	D318452-IR-4- Ginseng ¹
Aqueous Photolysis half-life (pH 7)	0.42 days	D318452-IR-4- Ginseng ¹
Aerobic Aquatic Metabolism	3.75 days	D318452-IR-4- Ginseng ¹
Anaerobic Aquatic Metabolism	1.85 days	D318452-IR-4- Ginseng ¹
Aerobic soil half-life	1.25 days	D318452-IR-4- Ginseng ¹
Anaerobic soil half-life	1.85 days	D318452-IR-4- Ginseng ¹
Hydrolysis	0.25 days	D318452-IR-4- Ginseng ¹
Pesticide is wetted-in	No	Product label
Chemical Application method (CAM)	2 for foliar spray 4 for seed treatment	EFED Guidance ²
Application Efficiency	0.95 for foliar spray 0.99 for ground appl.	EFED Guidance ²

¹ IR-4- Local Registration for Captan Use on Ginseng, 2006 (D318448, D318449, D318450, D318451, and D318452)

² Guidance for selecting input parameters in modeling for environmental fate and transport of pesticides. Version II. February 27, 2002.

3.2.1 Aquatic Modeling Results

Using the various PRZM EXAMS scenarios and the application practices for captan the aquatic EECs were estimated. For foliar application to the food uses, the estimated aquatic exposures are highest for captan use on almonds at four applications with a peak EEC of 21.6 µg/L for aerial application (**Table 3.04**). The peak estimated aquatic exposure for captan use on golf courses, sod farms and dichondra grasses with a maximum of 2 applications is 12.2 µg/L for aerial application (**Table 3.05**). The peak estimated aquatic exposure for captan use on ornamental grasses with a maximum of 26 applications is 28.6 µg/L for ground application. For seed treatment for the food uses, the estimated aquatic exposure is highest for wheat with a peak EEC of 0.51 µg/L using the conservative assumption of no ground incorporation (**Table 3.06**). For grass/forage/fodder/ hays grown for seed using the California turf scenario and assuming a two inch incorporation depth, the estimated aquatic exposure is 4.05 µg/L. For application of captan as a lawn seedbed treatment with 3 inch incorporation, the peak estimated aquatic exposure is 15.64 µg/L.

The food use which resulted in the highest EECs was captan use on almonds. The maximum application rate is 4.5 lb a.i./A with 4 applications per year. Almond was also modeled at one application per year to estimate a lower bound of exposure. At one application, the peak EEC is 13.85 µg/L for aerial application as compared to the peak EEC of 21.6 µg/L for four applications (**Table 3.04**).

Table 3.04. Aquatic EECs (µg/L) for Captan Foliar Application to the Food Uses in California			
CROP	Peak EEC	21 day EEC	60 day EEC
ALMOND (4 applications)			
Aerial Application	21.567	1.3467	0.5911
Ground Application	11.995	0.5541	0.2190
ALMOND (1 application)			
Aerial Application	13.853	0.414	0.145
APPLE			
Aerial Application	11.19	1.465	0.8281
Ground Application	2.239	0.293	0.1656
APRICOT			
Aerial Application	6.998	0.9303	0.3256
Ground Application	1.4	0.1861	0.0651
CANEBERRY (BLACKBERRY/ RASPBERRY)			
Aerial Application	5.597	0.444	0.2690
Ground Application	1.1271	0.0986	0.0604
BLUEBERRY			
Aerial Application	10.1663	0.6886	0.6336
Ground Application	5.3309	0.2458	0.1653
CHERRY			
Aerial Application	5.597	0.5183	0.3893
Ground Application	2.6275	0.1624	0.0984
DEWBERRY			
Aerial Application	8.771	0.6956	0.2542
Ground Application	1.754	0.1448	0.0580
GINSENG			
Aerial Application	5.597	0.4460	0.4153
Ground Application	1.119	0.0892	0.0831
GRAPES			
Aerial Application	5.5979	0.4637	0.3227
Ground Application	1.12	0.1173	0.0728
LOGANBERRY			
Aerial Application	5.4818	0.7422	0.2640
Ground Application	1.4729	0.1584	0.0599
NECTARINE			
Aerial Application	11.2	1.786	0.62520
Ground Application	2.239	0.3572	0.125
PEACH			
Aerial Application	11.2	2.081	0.8318
Ground Application	2.239	0.4162	0.1664
PLUM/ PRUNE			
Aerial Application	8.396	0.6698	0.6998
Ground Application	1.679	0.134	0.1400
STRAWBERRY			
Aerial Application	8.396	0.7425	0.6517
Ground Application	2.7934	0.208	0.1512

Table 3.05. Aquatic EECs (µg/L) for Captan Foliar Application to Turf and Ornamental Uses in California			
Crop	Peak EEC	21 day EEC	60 day EEC
Golf course turf/ Sod Farms (2 applications)			
Aerial Application	12.215	0.732	0.256
Ground Application	3.605	0.220	0.077
Ornamental Grasses (26 applications)			
Aerial Application	27.474	1.194	1.093
Ground Application	28.571	0.761	0.298

Table 3.06. Aquatic EECs (µg/L) for Captan Seed Treatment in California			
Crop	Peak EEC	21 day EEC	60 day EEC
Alfalfa/ CA alfalfa	0.028	0.00076	0.00027
Clover/ CA alfalfa	0.024	0.00065	0.00023
Flax/ CA alfalfa	0.019	0.00052	0.00018
Barley/ CA wheat	0.17	0.0046	0.0016
Wheat (1.5” incorporation)/ CA wheat	0.30	0.0082	0.0029
Wheat (no incorporation)/ CA wheat	0.51	0.014	0.0049
Sorghum/ CA wheat	0.027	0.0007	0.00026
Oats/ CA wheat	0.21	0.0058	0.0020
Rye/ CA wheat	0.25	0.0068	0.0024
Beets/ CA row crop	0.0066	0.00018	6.28E-05
Pepper/ CA row crop	0.0011	2.99E-05	1.05E-05
Tomato/ CA tomato	0.00012	4.69E-06	1.64E-06
Broccoli/ Cabbage/ Cauliflower /CA cole crop	0.0013	3.49E-05	1.22E-05
Collards/CA cole crop	0.0015	4.13E-05	1.45E-05
Kale/CA cole crop	0.0019	5.08E-05	1.78E-05
Mustard greens/CA cole crop	0.016	0.00045	0.00016
Brussels sprouts/ CA lettuce	0.00072	2.17E-05	7.59E-06
Spinach/ CA lettuce	0.059	0.0018	0.00062
Melons-water/ CA melons	0.059	0.0018	0.00062
Melons-musk/ CA melons	1.47E-06	3.89E-08	1.36E-08
Melons-cantaloupe/ CA melons	2.26E-06	5.98E-08	2.09E-08
Squash/ CA melons	1.47E-06	3.89E-08	1.36E-08
Cucumber/ CA melons	1.73E-06	4.59E-08	1.61E-08
Onion/ CA onion	0.0038	0.00010	3.59E-05
Radish/ CA onion	0.0020	5.34E-05	1.87E-05
Potato/ CA potato	0.094	0.0027	0.00095
Turnip/ CA potato	0.094	0.0027	0.00095
Grass/Forage/Fodder/ Hayes grown for seed 2” incorporation/ CA turf	4.049	0.113	0.040

Grass seed Bed Treatment 3" incorporation/ CA turf ¹	15.64	0.438	0.153
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¹This use is not a seed treatment use but it was modeled similar to seed treatment in PRZM/EXAMS to account for the 3" incorporation depth.

3.2.2 Existing Monitoring Data

A critical step in the process of characterizing EECs is comparing the modeled estimates with available surface water monitoring data. Captan has a limited set of surface water monitoring data relevant to the CRLF assessment. Most of this data is non-targeted (i.e., study was not specifically designed to capture captan concentrations in high use areas). Data from the USGS NAWQA program (<http://water.usgs.gov.nawqa>) and California Department of Pesticide Regulation (CDPR) was searched for captan data. In addition, air monitoring data for captan are summarized.

3.2.2.1 Surface Water Monitoring Data

The California Department of Pesticide Regulation (CDPR) monitoring program data were accessed and reviewed. Sampling for captan only occurred on one day, December 13, 1994; therefore, this data was deemed insufficient for analysis. The sampling that occurred found no detectable levels of captan at 4 sites in Santa Cruz County and 3 sites neighboring Monterey County. The surveyed sites included a slough, a lagoon, a river, and drainage ditches. The CDPR data contained no information regarding captan degradates. At present time, neither captan nor its degradates are included in the USGS-NAWQA.

3.2.2.2 Atmospheric Monitoring Data

Ambient air monitoring for captan and THPI was conducted four days a week from May 11 through June 4, 1993, at three sites in Kern County. The background site was located at the California Air Resources Board air monitoring station in Bakersfield. Monitoring coincided with expected applications to grape vineyards. All samples analyzed were below the minimum detection level (MDL). The captan MDL is 0.013 µg/m³ (1.1 ppt) and THPI MDL is 0.026 µg/m³ (4.3 ppt) for 24 hour samples.

Application site monitoring for captan and THPI was conducted in May 1993 before, during, and for 72 hours after an application to a grape vineyard. In Tulare County captan was applied by ground equipment at the rate of 3.9 pounds of active ingredient per acre. Thirty-six of 40 samples analyzed for captan were below the MDL. All samples for THPI were below the MDL.¹⁰

3.2.3 Spray Drift Buffer Analysis

¹⁰ From California Air Resources Board (2002). *Pesticide Air Monitoring Results*. California Department of Pesticide Programs/EH- 02-01.

When considering the terrestrial habitats of the CRLF, spray drift from use sites onto non-target areas could potentially result in exposures of the CRLF, its prey and its habitat to captan. Therefore, it is necessary to estimate the distance from the application site where spray drift exposures do not result in LOC exceedances for organisms within the terrestrial habitat.

Since spray drift is the most likely means through which non-target terrestrial organisms will be potentially exposed to captan, the AGDISP model (version 8.13) is used to estimate the terrestrial distance from the site of application to where RQs are predicted to fall below the endangered species LOC. The highest single maximum application rate allowed on the label for captan uses were modeled to determine the maximum potential off-site estimated environmental concentrations (EECs) for a single application based on upper bound Kenaga values. The highest single maximum application rate was determined for each land use type including agriculture (includes ornamentals) and orchard/ vineyard. Almond is the orchard/vineyard crop with the highest application rate with a single application of 4.5 lb a.i./acre. Ornamental grasses is the agriculture crop with the highest application rate with a single application of 4.3 lb a.i./acre.

Aerial application is modeled since spray drift is expected to travel further with aerial applications than with ground applications because of the higher release heights. **Table 3.07** has selected input parameters used in AGDISP modeling.

Table 3.07. AGDISP Input parameters for almond and captan formulation	
Application. Method	Aerial (Air Tractor AT 401)
Almond canopy Height	30 ft
Release height	40ft
Swath Displacement	½ swath
Spray Volume	10 gal·acre ⁻¹
Non-volatile fraction	0.1
Active Fraction	0.0374
Specific Gravity (carrier)	1.0
Specific Gravity (captan)	1.27
Fraction of applied ¹	0.0267
Initial average deposition ²	0.120
¹ = LOC/RQ	
² = (Fraction of applied) x (Application rate for almond in lbs a.i./acre)	

A single application was modeled versus multiple applications because it is unlikely that the same terrestrial invertebrate would be exposed to the maximum amount of spray drift from multiple applications. For a terrestrial organism to receive the maximum concentration of captan from multiple applications, it would require that each application is made under identical atmospheric conditions (*e.g.*, same wind speed and same wind direction) and the terrestrial organism being exposed is located in the same location (which receives the maximum amount of spray drift) after each application.

Additionally, certain factors, including variations in topography, cover, and meteorological conditions over the transport distance are not accounted for by the AGDISP model (*i.e.*, it models spray drift from aerial and ground applications in a flat area with little to no ground cover and a steady, constant wind speed and direction). Therefore, in most cases, the drift estimates from AGDISP will overestimate exposure, especially as the distance increases from the site of application, since the model does not account for potential obstructions (*e.g.*, large hills, berms, buildings, trees, *etc.*). For this assessment, a single application was assessed.

Furthermore, conservative assumptions are made regarding the droplet size distributions being modeled ('ASAE Very Fine to Fine' for almond uses and the application method (aerial), release heights and wind speeds. Alterations in any of these inputs would decrease the area of potential effect. As noted in Section 3.2.4.2, no captan was detected in the air monitoring studies conducted in CA during the months of captan application. Therefore, it is unlikely that any terrestrial invertebrate outside the buffer from the site of captan application would actually receive a level of exposure high enough to cause an adverse effect.

3.2.4 Downstream Dilution Analysis

In order to determine the extent of the action area in aquatic habitats, the agricultural and orchard uses resulting in the greatest ratios of the RQ to the LOC for any endpoint for aquatic organisms is used to determine the distance downstream for concentrations to be diluted below levels that would be of concern (*i.e.* result in RQs above the LOC). To complete this assessment, the greatest ratio of aquatic RQ to LOC was estimated. This ratio is used to identify all stream reaches downstream from the initial area of concern where the percent cropped area (PCA) for the land uses identified for captan are greater than 1/20 or 5%. All streams identified as draining upstream catchments greater than 5% of the land class of concern, would be considered part of the action area. Results are shown in Section 5.1.4.

3.2 Terrestrial Animal Exposure Assessment

T-REX (Version 1.3.1) is used to calculate dietary and dose-based EECs of captan for the CRLF and its potential prey (*e.g.* small mammals and terrestrial insects) inhabiting terrestrial areas. EECs used to represent the CRLF are also used to represent exposure values for frogs serving as potential prey of CRLF adults. T-REX simulates a 1-year time period. For this assessment, spray applications and seed treatment of captan are considered.

Maximum exposure levels were calculated for spray applications of captan using the maximum use rate for the food uses (peach) of 4 lbs ai/A of 8 applications at a 3-day application interval. In addition, minimum exposure levels were calculated for spray applications of captan using the minimum use rate for the food uses (caneberries) of 2 lb ai/A of 5 applications at a 10-day application interval. This range of exposure estimates the bounds for all of the food uses. Maximum exposure levels were also calculated for

application of captan to turf and ornamental grasses. Use specific input values, including number of applications, application rate and application interval are provided in **Table 3.08**.

Foliar dissipation half-lives are incorporated into the TREX model. The default foliar dissipation half-life of 35 days was used to provide an upper bound captan residue concentration on foliage (Willis and McDowell, 1987). Additionally, a foliar residue wash-off half-life of 10 days was used to estimate captan concentrations on foliage (U.S EPA, 1999). Results are presented using both the 10-day (lower bound) and 35-day (upper bound) half lives. It should also be noted that any captan that reaches the soil surface after application would be subject to an aerobic soil metabolism half-life of less than a day.

Table 3.08. Input Parameters for Foliar Applications Used to Derive Terrestrial EECs for Captan with T-REX		
Use (Application method)	Application rate (lbs ai/A)	Number of Applications and Interval
Caneberry/ Raspberry/Blackberry	2	5, 10-day
Peach	4	8, 3-day
Golf course turf/ sod farm (turf)/ dichondra grasses	4.3	2, 7-day
Ornamental grasses	6.39	26, 7-day

For modeling purposes, exposures of the terrestrial phase of the CRLF to captan through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential mammalian prey are assessed using the small mammal (15 g) which consumes short grass. Upper-bound Kenega nomogram values reported by T-REX for these two organism types are used for derivation of EECs for the CRLF and its potential prey (**Table 3.09**).

Table 3.09. Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the Terrestrial-phase CRLF and its Prey to Captan (EECs bracketed between foliar dissipation half lives of 10 and 35 days).				
Use	EECs for Terrestrial-phase CRLF (small birds consuming small insects)		EECs for Mammalian Prey (small mammals consuming short grass)	
	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)
Caneberry/ Raspberry/Blackberry	523 - 945	596 - 1076	930 - 1679	887 - 1601
Peach	2331 - 3542	2655 - 4033	4144 - 6296	3951 - 6003
Golf course turf/ sod farm (turf)/ dichondra grasses	938 - 1086	1068 - 1237	1667 - 1930	1590 - 1841
Ornamental grasses (26 appl)	1510 - 4362	1720 - 4968	2685 - 7755	2559 - 7394

T-REX is also used to calculate EECs for terrestrial insects exposed to captan. Available acute contact toxicity data for bees exposed to captan (in units of $\mu\text{g a.i./bee}$), are

converted to $\mu\text{g a.i./g}$ (of bee) by multiplying by 1 bee/0.128 g. Dietary-based EECs calculated by T-REX for captan residues on small and large insects (units of a.i./g) are used to bound an estimate of exposure to bees. The EECs are later compared to the adjusted acute contact toxicity data for bees in order to derive RQs (**Table 3.10**).

Table 3.10. EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items (EECs bracketed between foliar dissipation half lives of 10 and 35 days).		
Use	Small Insect	Large Insect
Caneberry/ Raspberry/Blackberry	523 - 945	58 - 120
Peach	2331 - 3542	259 - 394
Golf course turf/ sod farm (turf)/ dichondra grasses	938 - 1086	104 - 121
Ornamental grasses	1510 - 4362	168 - 485

The T-HERPS model was used to refine dose-based risk estimations. T-HERPS is a modification of T-REX which includes amphibian/reptile specific allometric equations, weight classes appropriate for the CLRF, and prey items specific to the CLRF. It is important to note that while the allometric equations and prey items are more specific to the frog, the toxicity data used in this assessment are that for a surrogate species (bobwhite quail and mallard duck). It is unknown what direction use of the surrogate toxicity data might bias the estimate. T-HERP groups the frogs into three classes: small (1.4g), medium (37g), and large (238g). The two smaller weight classes most closely approximate the 20g juvenile that exceeded LOCs using the T-REX model. EEC are provided in **Table 3.11**.

Table 3.11. EECs for Direct Effects to the terrestrial-phase CRLF, based on captan exposures resulting from applications to peaches (highest foliar application rate) with 10-day foliar dissipation half-life.			
Food	Dose-based Acute EEC 1.4 g CRLF	Dose-based EEC 37 g CRLF	Dose-based EEC 238 g CRLF
Small Insects	91	89	58
Large Insects	10	10	6
Small Herbivore mammals	NA	NA	402
Small Insectivore mammals	NA	NA	25
Small Terrestrial-phase Amphibians	NA	NA	2

NA: Not Applicable (size class of frog too small to consume mammals and amphibians)

TerrPlant (Version 1.1.2) is used to calculate EECs for non-target plant species inhabiting dry and semi-aquatic areas. EECs were estimated based on the use with the highest single application rate, almond at 4.5 lb a.i./A for aerial application. A runoff value of 0.01 is utilized based on captan's solubility, which is classified by TerrPlant as <10 mg/L. Drift is assumed to be 5% for aerial application. Soil incorporation is assumed to be 1 for aerial applications. EECs relevant to terrestrial plants consider pesticide concentrations in drift and in runoff. EECs for spray drift alone, total for dry areas, total for semi-aquatic areas are 0.23, 0.27, and 0.68 lbs ai/acre. An example output from TerrPlant v.1.1.2.2 is available in **Appendix K**.

4. Effects Assessment

This assessment evaluates the potential for captan to directly or indirectly affect the CRLF or modify its designated critical habitat. As previously discussed in **Section 2.7**, assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of CRLF, as well as indirect effects, such as reduction of the prey base and/or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating effects to the PCEs, which are components of the critical habitat areas that provide essential life cycle needs of the CRLF. Direct effects to the aquatic-phase of the CRLF are based on toxicity information for freshwater fish, while terrestrial-phase effects are based on avian toxicity data, given that birds are generally used as a surrogate for terrestrial-phase amphibians. Because the frog's prey items and habitat requirements are dependent on the availability of freshwater fish and invertebrates, small mammals, terrestrial invertebrates, and aquatic and terrestrial plants, toxicity information for these taxa are also discussed. Acute (short-term) and chronic (long-term) toxicity information is characterized based on registrant-submitted studies and a comprehensive review of the open literature on captan.

As described in the Agency's Overview Document (U.S. EPA, 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include aquatic-phase amphibians, freshwater fish, freshwater invertebrates, aquatic plants, birds (surrogate for terrestrial-phase amphibians), mammals, terrestrial invertebrates, and terrestrial plants.

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (U.S. EPA, 2004). In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

- (1) the toxic effects are related to single chemical exposure;
- (2) the toxic effects are on an aquatic or terrestrial plant or animal species;
- (3) there is a biological effect on live, whole organisms;
- (4) a concurrent environmental chemical concentration/dose or application rate is reported; and

- (5) there is an explicit duration of exposure.

Data that pass the ECOTOX screen are evaluated along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. In general, effects data in the open literature that are more conservative than the registrant-submitted data are considered. The degree to which open literature data are quantitatively or qualitatively characterized is dependent on whether the information is relevant to the assessment endpoints (*i.e.*, maintenance of CRLF survival, reproduction, and growth) identified in Section 2.8. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, unless quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are available.

Citations of all open literature not considered as part of this assessment because they were either rejected by the ECOTOX screen or accepted by ECOTOX but not used (e.g., the endpoint is less sensitive and/or not appropriate for use in this assessment) are included in **Appendix G**. Rationales for rejection of those studies that did not pass the ECOTOX screen are included in **Appendix G**. Rationales for those studies that did pass the ECOTOX screen but were not included in this endangered species risk assessment are:

- Endpoint not more sensitive than submitted data
- Efficacy data not useful for assessment
- Exposure route not relevant for the CRLF
- Study was not conducted using captan (error in the ECOTOX screen)
- Exposure levels could not be converted to units useful for risk assessment (e.g., could not convert to lbs ai/acre for terrestrial plants or to $\mu\text{g ai/individual}$ for bees)

In addition to registrant-submitted and open literature toxicity information, other sources of information, including use of the acute probit dose response relationship to establish the probability of an individual effect and reviews of the Ecological Incident Information System (EIIS), are utilized to further refine the characterization of potential ecological effects associated with exposure to captan. A summary of the available aquatic and terrestrial ecotoxicity information, use of the probit dose response relationship, and the incident information for captan are provided in Sections 4.1 through 4.4, respectively.

The captan degradates, THPI and THPAm, are less toxic than the parent compound for aquatic receptors. As shown in **Table 4.01**, comparison of available toxicity information indicates lesser aquatic toxicity than the parent for freshwater fish, invertebrates, and aquatic plants. Toxicity data for terrestrial species are not available for the degradates. Because the degradates are several orders of magnitude less toxic than the parent, the degradates were not assessed for effects to the CRLF.

Table 4.01. Comparison of Aquatic Acute Toxicity Values for Captan and degradates			
Substance Tested	Fish LC₅₀ (µg/L)	Daphnid EC₅₀ (µg/L)	Aquatic Plant EC₅₀ (µg/L)
Captan	26.2	8400	320
THPI	> 120,000	>113,000	>180,000
THPAm	> 126,000	No data	No data

4.1 Toxicity of Captan to Aquatic Organisms

Table 4.02 summarizes the most sensitive aquatic toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature, as previously discussed. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the CRLF is presented below. Additional information is provided in **Appendix A**.

Table 4.02. Aquatic Toxicity Profile for Captan				
Assessment Endpoint	Surrogate Species	Toxicity value used in the risk assessment	Source Citation	Comments
<i>Direct Effects</i>				
Acute Toxicity to Frog (Aquatic Phase)	<i>Salmo trutta</i> (Brown trout)	LC ₅₀ = 26.2 µg/L Very Highly Toxic Probit slope unavailable, no partial mortalities	MRID 40098001	Supplemental
Chronic Toxicity to Frog (Aquatic Phase)	<i>Pimephales promelas</i> (Fathead minnow)	NOAEC = 16.5 µg/L LOAEC = 39.5 µg/L	MRID 00057846	Acceptable Reductions in adult and larval survival, growth and overall larval-juvenile development, survival of the juvenile species, a reduction in eggs laid, and an inability for juveniles to reproduce
<i>Indirect Effects (Prey Reduction)</i>				
Acute Toxicity to Aquatic Invertebrates	<i>Daphnia magna</i> (Water flea)	EC ₅₀ = 8400 µg/L Slope= 1.187 Moderately Toxic	MRID GS0120041	Acceptable
Chronic Toxicity to Aquatic Invertebrates	<i>Daphnia magna</i> (Water flea)	NOAEC = 560 µg/L LOAEC = 1000 µg/L	MRID 441488-01	Supplemental
<i>Indirect Effects (Habitat Modification)</i>				
Acute Toxicity to Plants (non-vascular)	<i>Scenedesmus subspicatus</i> (Green Algae)	EC ₅₀ = 320 µg/L	MRID 00137688	Supplemental
Acute Toxicity to Plants (vascular)	<i>Lemna gibba</i> (Duckweed)	LC ₅₀ > 12,700 µg/L	MRID 44806503	Acceptable

4.1.1 Toxicity to Freshwater Fish and Amphibians

Ecotoxicity data for freshwater fish are generally used as surrogates for aquatic-phase amphibians when amphibian toxicity data are not available (U.S. EPA, 2004). Some amphibian data were located in ECOTOX (#90515). Toxicity data for two species, the African clawed frog (*Xenopus laevis*,) and the Spanish ribbed newt (*Pleurodeles waltl*) indicated that mortality effects for amphibians occur in concentrations similar to lethal endpoints for fish (Mouchet *et al*, 2006). Acute toxicity for *Xenopus laevis* resulted in $LC_{50} = 119.4 \mu\text{g/L}$ for exposure to captan in mineral water and $LC_{50} = 354 \mu\text{g/L}$ in reconstituted water. Acute toxicity for *Pleurodeles waltl* resulted in $LC_{50} = 311 \mu\text{g/L}$ for exposure to captan in mineral water and $LC_{50} = 500 \mu\text{g/L}$ in reconstituted water. Captan had genotoxic effects, including impacts to DNA structure and cell reproduction, in both species at concentrations of $62.5 \mu\text{g/L}$ (in mineral water) and higher. The results of this study are based on nominal concentrations because measured concentrations were not taken. In addition, turbidity was observed in the reconstituted water treatments; therefore, there are uncertainties associated with the results of this study. Thus EFED used the toxicity value from the fish data to calculate RQs.

Freshwater fish data were used as a surrogate to estimate direct acute and chronic risks to the CRLF. Freshwater fish toxicity data were also used to assess potential indirect effects of captan to the CRLF. Direct effects to freshwater fish resulting from exposure to captan may indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

Captan is highly toxic to very highly toxic to freshwater fish ($LC_{50} = 26.2 - 137 \mu\text{g/L}$) on an acute basis. The brown trout was found to be the most sensitive freshwater fish species tested ($LC_{50} = 26.2 \mu\text{g/L}$, MRID 40098001). Due to lack of partial mortalities the probit slope could not be determined for this study.

A freshwater fish early life-stage chronic toxicity study on fathead minnow (*Pimephales promales*) was used to evaluate the chronic toxicity of captan. Captan had an NOAEC of $16.5 \mu\text{g/L}$ and an LOAEC of $39.5 \mu\text{g/L}$ (MRID 00057846). Endpoints affected in the study include adult and larval survival rate, growth and overall larval-juvenile development, survival of the juvenile species, a reduction in eggs laid, and an inability for juveniles to reproduce for freshwater fish exposed to captan.

4.1.2 Toxicity to Freshwater Invertebrates

Freshwater aquatic invertebrate toxicity data were used to assess potential indirect effects of captan to the CRLF. Direct effects to freshwater invertebrates resulting from exposure to captan may indirectly affect the CRLF via reduction in available food items. As discussed in Section 2.5.3, the main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic invertebrates found along the shoreline and on the water surface, including aquatic sowbugs, larval alderflies and water striders.

Acute freshwater toxicity tests using the *Daphnia magna* indicate captan is moderately toxic ($LC_{50} = 8400 \mu\text{g/L}$; MRID GS0120041). A freshwater early-life-stage cycle test using the *Daphnia magna* exposed to captan was submitted (MRID 441488-01). Captan is categorized as a reproductive inhibitor in freshwater invertebrates due to parental and juvenile reductions in growth, survival, length as well as decreased number of juveniles. The NOAEC and LOAEC values were 560 and 1000 $\mu\text{g/L}$, respectively. There are uncertainties associated with the results of this study because the test material was reported as being unstable in the water and the test concentration in the exposure solutions were not measured during the test. The endpoints are based on nominal concentrations. Risk may be underestimated because measured concentrations were not provided.

4.1.3 Toxicity to Aquatic Plants

Aquatic plant toxicity studies were used as one of the measures of effect to evaluate whether captan may affect primary production and the availability of aquatic plants as food for CRLF tadpoles. Primary productivity is essential for indirectly supporting the growth and abundance of the CRLF.

Toxicity of captan to nonvascular aquatic plants is based on the green algae, *Scenedesmus subspicatus* toxicity study ($EC_{50} = 320 \mu\text{g/L}$; MRID 00137688) which used nominal concentrations. There are uncertainties associated with the results of this study because the endpoints are based on nominal concentrations, risk may be underestimated. However, RQs were estimated based on this study because it represents the most conservative toxicity results. In a *Selenastrum capricornutum* (green algae) toxicity study, the $EC_{50} = 1770 \mu\text{g/L}$ (MRID 43869809). In an *Anabaena flos-aquae* (freshwater algae) toxicity study, the $EC_{50} = 1200 \mu\text{g/L}$ (MRID 44806501). Toxicity of captan to vascular aquatic plants is based on the duckweed, *Lemna gibba* toxicity study ($EC_{50} > 12,700 \mu\text{g/L}$; MRID 44806503).

4.2 Toxicity of Captan to Terrestrial Organisms

Table 4.03 summarizes the most sensitive terrestrial toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the CRLF is presented below.

Table 4.03. Terrestrial Toxicity Profile for Captan				
Assessment Endpoint	Surrogate Species	Toxicity Value Used	Citation/MRID	Comments
<i>Direct Effects</i>				
Acute Toxicity to Frog (Terrestrial Phase)	Mallard Duck	LD ₅₀ > 2000 mg/kg bw (dose)	GS9999-001 Hudson, 1984	Practically non-toxic
	Northern bobwhite quail	LC ₅₀ > 2400 mg/kg diet (dietary)	MRID 00022923 Hill, 1975	Slightly to practically non-toxic
Chronic Toxicity to Frog (Terrestrial Phase)	Mallard Duck and Bobwhite Quail	NOAEC > 1000 mg/kg diet	MRID 00098295 and 00098296 Fink, 1980	No affected endpoints reported
<i>Indirect Effects (Prey Reduction)</i>				
Acute Toxicity to Terrestrial Invertebrates	<i>Osmia ligaria</i> Blue Orchard Bee	LD ₅₀ = 270 µg/bee	Ecotox # 87252	Acute Contact Toxicity
Acute Toxicity to Rat	Rat	LD ₅₀ > 5,000 mg/kg diet	MRID 164355	Practically non-toxic
		LD ₅₀ = 9,000 mg/kg diet	MRID 00054789	
Chronic Toxicity to Rat	Rat	NOAEL= 250 mg/kg diet	MRID 00125293	Decreases in the mean litter weights of pups and sexual organ atrophy in adults and pups
<i>Indirect Effects (Habitat Modification)</i>				
Acute Toxicity to Terrestrial Plants (Wetland)	NO APPROPRIATE QUANTITATIVE DATA AVAILABLE			
Acute Toxicity to Terrestrial Plants (Upland)				

4.2.1 Toxicity to Birds

As specified in the Overview Document, the Agency uses birds as a surrogate for terrestrial-phase amphibians when amphibian toxicity data are not available (U.S. EPA, 2004). No terrestrial-phase amphibian data are available for captan; therefore, acute and chronic avian toxicity data are used to assess the potential direct effects of captan to terrestrial-phase CRLFs.

Captan is practically non-toxic on an oral acute basis for the mallard duck (LD₅₀ >2,000 mg/kg bw) and the Northern bobwhite quail duck (LD₅₀ >2,150 mg/kg bw). Captan is also practically non-toxic on a sub-acute dietary basis to the mallard duck, Japanese quail, and ring-necked pheasant (LC₅₀ >5,000 mg/kg diet) and slightly toxic to practically non-toxic to the Northern bobwhite quail (LC₅₀ >2,400 mg/kg diet). No mortalities occurred at any dose level tested in the acute avian studies.

The mallard duck and bobwhite quail reproduction studies indicate that exposure at the three test concentrations of 100, 300, and 1000 mg/kg diet did not affect reproduction (NOAEC > 1000 mg/kg diet; MRID 00098295, 00098296).

4.2.2 Toxicity to Mammals

Mammalian toxicity data are used to assess potential indirect effects of captan to the terrestrial-phase CRLF. Direct effects to small mammals resulting from exposure to captan may also indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

Captan is practically non-toxic for oral acute toxicity to mammals (LD_{50} > 5,000 mg/kg/diet, MRID 164355). There was one dose tested (5,000 mg/kg diet). Some mortality was observed in the study. Two males died. One death occurred on day 1 and one on day 12. One female died on day 4. The deaths were treatment related according to necropsy. In a previous study, captan was classified as practically non-toxic for oral acute toxicity to mammals (LD_{50} = 9,000 mg/kg/diet, MRID 00054789, 1949). The assessment for CRLF is based on the definitive endpoint (LD_{50} = 9,000 mg/kg/diet).

Chronic studies in rats and rabbits show that captan exposure caused malformation of nephronic cells in the kidneys (in both males and females), testicular and testes atrophy in males, vaginal and uterine atrophy in females, decreased body weight gains in both sexes, reduced ossification in both males and females; sexual organ atrophy in pups (males and females), and decreased mean litter weights.

For this assessment, the chronic three-generation reproduction toxicity endpoint (NOAEL = 250 mg a.i./kg diet) for the laboratory rat was used for estimating chronic effects from captan exposure. Results of the study showed decreases in the mean litter weights of pups and severe sexual organ atrophy in adults and pups. Additionally, there were also signs of severe changes in liver weights in the adult males as well as abdominal and intestinal atrophy. In females, there were signs of stomach atrophy and esophageal atrophy.

4.2.3 Toxicity to Terrestrial Invertebrates

Terrestrial invertebrate toxicity data are used to assess potential indirect effects of captan to the terrestrial-phase CRLF. Direct effects to terrestrial invertebrates resulting from exposure to captan may also indirectly affect the CRLF via reduction in available food.

In a registrant submitted acute contact study, the honey-bee, *Apis mellifera*, was exposed to the technical grade captan and the result was LD_{50} > 10 µg/bee. In an additional study, honeybees were dusted with 215 µg a.i./bee (technical) and there was 9.86% mortality at 48-hours. Captan is categorized as practically non-toxic to non-targeted terrestrial insects on an acute toxicity basis (MRID # 00113613, 05001991).

The most sensitive terrestrial invertebrate study in the open literature was also reviewed. In an acute toxicity test, female blue orchard bees (*Osmia ligaria*) were exposed to the formulated product, Captan 50WP (48.9% captan). The 72- hour LD₅₀ for acute contact and oral endpoints were 269.7 and 46.26 µg a.i./bee, respectively (Ladurner et. al, 2005, ECOTOX ref # 87252). The 48-hour acute oral LD₅₀ was 100.45 µg a.i./bee. The 48-hour acute contact LD₅₀ could not be determined because it was greater than the highest dose tested. The 72-hour definitive acute contact results were used in the assessment although it was not the most sensitive because there are several uncertainties in determining the exposure concentration for the oral endpoint due to lack of information about allometric relationships between residues and bee ingestion.

4.2.4 Toxicity to Terrestrial Plants

Terrestrial plant toxicity data are used to evaluate the potential for captan to affect riparian zone and upland vegetation within the action area for the CRLF. Impacts to riparian and upland (i.e., grassland, woodland) vegetation may result in indirect effects to both aquatic- and terrestrial-phase CRLFs, as well as modification to designated critical habitat PCEs via increased sedimentation, alteration in water quality, and reduction in of upland and riparian habitat that provides shelter, foraging, predator avoidance and dispersal for juvenile and adult CRLFs.

Because the Agency waived submission of terrestrial plant toxicity studies for captan, there are no guideline terrestrial plant toxicity studies submitted for the exposure to captan to terrestrial vascular and non-vascular plants (U.S. EPA, 1999).

Several papers describing studies evaluating toxicity of captan to plants were found in the open literature search (ECOTOX). Some papers evaluated the effect of captan seed treatment on germination rates and seedling growth. A brief summary of some of these studies is given in **Table 4.04**. For these studies, application rates were provided in lbs ai/cwt-seed. None of these papers reported any negative effects of captan on germination or growth of seedlings. IC₂₅'s could not be calculated as only one application rate was utilized in each of the studies; although the application rate can be considered a NOAEC.

Table 4.04. Summary of selected ECOTOX papers evaluating effect of captan seed treatment on germination and growth.			
ECOTOX reference	Crop	Application rate	Results
91004 (McLaren, N. <i>et al</i> , 1989)	Sorghum	0.30 lbs ai/cwt	No difference in average dry weight of 25 seedlings 21days after planting.
91168 (Mantecon, J. D., 1989)	Durum wheat	0.26 lbs ai/cwt	Seedling survival rate higher than control at all time points (7, 14, 21, 28 days). Seeds planted in control and treated groups were infested with <i>Fusarium graminearum</i> .
91007 (Fahim <i>et al</i> , 1983)	Lupin	0.50 lbs ai/cwt	At the end of growing season, average weight of 100 seeds in the treated group was the same or greater than in the control. Percent occurrence of diseased plants was less in treated group than in control group. Soil in both groups had been inoculated with <i>Fusarium oxysporum</i> .
90836 (Davis, M. et al, 2001)	Grain sorghum	0.16 lbs ai/cwt	In greenhouse, increase or no difference in survival and fresh shoot weight at 28 days (for either naturally infested soil or autoclaved soil). In field trial, increase or no difference in survival (plants/m ²) 13-20 days after planting or in vigor or grain yield 26-72 days after planting.

Some open literature papers evaluating terrestrial plant toxicity were identified in which a foliar spray was used to apply captan. For a majority of the papers an application rate in terms of lbs ai/acre could not be determined. It should be noted that for these papers, few described any lasting phytotoxic effects of the plants.

One paper was identified in ECOTOX in which an application rate in lbs ai/acre could be determined (Polavarapu, S., 2000, ECOTOX #63909). Two formulations of captan (Captan 80WP and Captec 4L) were applied to highbush blueberries at 2.5 lbs ai/acre using a backpack sprayer in six different experiments. Two formulations of diazinon (Diazinon AG600 and Diazinon 50WP) were also applied alone or in combination with captan. Phytotoxicity of fruit and foliage clusters were recorded. Applied alone, captan formulations caused mild phototoxicity (spots) in a small percentage of fruit and leaves; however, in most cases the injury was superficial and the fruit and leaves recovered by harvest time. Application of captan and diazinon simultaneously caused greater phytotoxicity to fruit and leaves than if either chemical was applied alone. The authors concluded that tank mixes of captan and diazanon should not be recommended on highbush blueberries, but determined that if applications of the two chemicals were at least 8 hrs apart, observed phytotoxicity was minimal.

4.3 Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and

aquatic animals that may indirectly affect the listed species of concern (U.S. EPA, 2004). As part of the risk characterization, an interpretation of acute RQ for listed species is discussed. This interpretation is presented in terms of the chance of an individual event (i.e., mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to captan on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available. Based on a review of the acute toxicity for captan, no dose response information is available to estimate a slope for this analysis; therefore, a default slope assumption of 4.5 (with lower and upper bounds of 2 to 9) (Urban and Cook, 1986) is used.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. In addition, the acute RQ is entered as the desired threshold.

4.4 Incident Database Review

A review of the EIIS database for ecological incidents involving captan was completed on September 7, 2007. The results of this review for aquatic, terrestrial, and plant incidents are discussed below in Sections 4.4.1 through 4.4.3, respectively.

4.4.1 Aquatic Incidents

Two captan incidents have been reported involving aquatic organisms. The first incident, according to "Summary of Reported DDT, Endrin, and Methyl Parathion Episodes Involving Fish from 1967 to February, 1975" there was a large fish kill in the state of New York on May 24, 1972. A spray rig being filled with thiodan and captan overflowed into a stream, resulting in the death of 10,000 fish (Incident number B000-245-01). The reported certainty index for the fish incident was categorized as "highly probable" because although no analytical data were included in the report, it is certain that spillage of captan concentrate into a stream would be lethal to fish.

The second incident involved a resident of Hendersonville, NC, who complained that fish were killed in his pond as the result of runoff of pesticides from a neighboring orchard that was 90 feet away. The orchard is at a higher elevation and, thus, it is possible for runoff to occur. The orchard owner said that on August 9, 1994, he had applied Lorsban, Benlate, and Ziram, and on August 22 he had applied Imidan, Topsin-M, and Captan. Several days after that, a heavy rain occurred and the fish kill took place on August 29

according to the NC Dept of Agri. report. The pond owner said he noticed dead fish on August 19. The orchard owner had an oxygen test run on the water in the pond on August 25 but the results were not included in the report. Samples of water, sediment, soil, and vegetation were taken on September 7 which was considerably after the incident and they still showed benomyl in the water (9 and 57 ppb). Chlorpyrifos was found in the soil at concentrations of 35, 50, and 60 ppb, as was Captan (at 310 ppb). Samples of vegetation in the orchard had chlorpyrifos at 0.74 ppm, phosmet at 7.3 ppm, captan at 2.3 ppm, EBDC at 5.6 ppm, and benomyl at 2.5 ppm. The reported certainty index for the fish incident (I003826-020) was categorized as “unlikely”, because captan was found in the soil and on the vegetation but not in the water. As compared to the other pesticides, captan was less likely to be responsible for the incident.

4.4.2 Terrestrial Incidents

Five captan incidents have been reported involving terrestrial organisms, including two bird and three bee incidents. In the first incident, an estimated 30 to 35 snow geese were found in a field on the eastern shore of Virginia in Accomack County on January 30, 1985. Necropsies showed aquatic vegetation in the digestive tract but there were no gross lesions or evidence of infectious diseases. Because empty bags of Vitavax flowable fungicide were found in the nearby field it was assumed that the birds died of captan poisoning. The reported certainty index for the bird incident (I004169-006) was categorized as “probable”, because in the absence of analyses of tissue residues it can only be surmised that the birds died of captan poisoning, since there were empty bags that had contained this pesticide nearby.

In the second incident, in Hertford, North Carolina, on March 18, 1991, the investigators alleged that a potato field was treated with aldicarb. The treatment allegedly resulted in a bird kill. The farmer stated he had used no aldicarb on his potato field, only on tobacco. He said he used metolachlor on his potatoes. He had dusted potato seeds with captan before planting. Three soil samples revealed the presence of aldicarb but no other pesticide. Rain followed the observation of neighbors who observed the aldicarb application. Witnesses wanted to remain anonymous; this handicapped the investigation. Stomach content of one seagull revealed inconclusive results because the sample was too small. Three cats and one dog also suffered mortality during this event. It was emphasized that the applicator failed to follow packaging guidelines for safe handling of the pesticide. The NC Ag. Dept. ruled the event a misuse because the labeling of aldicarb states: "No longer labeled for use on potatoes." The reported certainty index for the bird incident (I000799-005) was categorized as “unlikely”, because captan was not revealed in the soil analysis and it is unlikely that it played a role in the observed bird mortality.

In a third incident, a bee kill occurred in Hendersonville on July 20, 1993. An investigation showed that a nearby orchard had been sprayed with Imidan (Phosmet), Topsin-M, and Captan. Phosmet was found to be present at 0.12 ppm in the bees, but there was no detection of Captan or Thiophanate methyl. All three of those compounds were found as residues on the vegetation, with Phosmet at 180 ppm, Captan at 400 ppm (on apple leaves), and Thiophanate Methyl at 57 ppm. The reported certainty index for

the bee incident (I003654-016) was categorized as “unlikely”, because captan was not found in the bees.

In the fourth incident, a bee keeper in Hendersonville, NC, complained that some of his bees died on August 14, 1994. The closest orchards were two miles away and they had been sprayed on August 3 or 4 with methyl parathion, chlorpyrifos, and Benlate. A sample of the dead bees, taken on August 15, contained methyl parathion at 0.77 ppm. Samples of vegetation taken at the orchards on August 18 (a little more than two weeks after the spraying) contained methyl parathion, chlorpyrifos, and captan. Methyl parathion was the cause of the bee kill. No violations were charged. The reported certainty index for the bee incident (I003826-027) was categorized as “unlikely”, because captan was not found in the bees.

In the fifth incident, a bee keeper in Hendersonville, NC, asked the NC Dept. of Agriculture to determine the cause of his bees' death. Accordingly the Ag. representative interviewed farmers in the surrounding area and learned that a variety of products had been used, but none admitted to spraying PennCap M, which is what the bee keeper suspected as being the cause of the incident. On April 18, 1995 Polyram and Nova (maneb, myclobutanil) were sprayed; on April 27, Sevin (carbaryl) was sprayed; on April 29 Phaser, Polyram, and Rubigan were sprayed (endosulfan, maneb, fenarimol); on April 18 a second farmer applied Polyram and Nova; on April 19 Captan and Rubigan (fenarimol) were sprayed along with sulfur. Dead bees were noticed on April 28 and some were collected for analysis on May 1, at which time various samples of vegetation were also taken. The dead bees contained 3.1 ppm methyl parathion, 0.10 ppm chlorpyrifos, dimethoate and metabolite (1.7 ppm), and endosulfan and metabolite (0.20 ppm). Vegetation from the nearby orchards contained various amounts of chlorpyrifos, captan, dimethoate, endosulfan, and carbaryl but no methyl parathion. The conclusion of the Dept. of Agriculture was that it could not identify the source of the methyl parathion which probably was mainly responsible for the bee deaths. The reported certainty index for the bee incident (I003826-009) was categorized as “unlikely”, because captan was not found in the bees.

4.4.3 Plant Incidents

Two captan incidents have been reported involving terrestrial plants. In the first incident, Gustafson LLC reported that there was an error by a formulator who added tebuconazole, an antimicrobial, to a 790 gallon lot of the fungicide Rival (Pentachloronitrobenzene [PCNB], thiabendazole, captan). This created a formulation of an unregistered end-use product for soybean seed treatment. About 403 gallons of this lot was sold to and used by 10 commercial seed treating companies for soybeans. The material was used in IL, IN, OH, MI and LA. Gustafson was notified on May 21, 2004 of stunting growth. The seed treating companies were notified and instructed to notify the growers to destroy their crops. The reported certainty index for the soybean incident (I015152-001) was categorized as “possible” for all four listed pesticides, because the damage was probably due to the accidental misuse of the pesticides involved. It could not be determined if an individual pesticide or some combination caused the stunted growth.

The second plant incident involved damage to apples. In order to comply with 6(a)2 regulations, Zeneca reported a complaint from North East, PA, that Abound (active ingredient of azoxystrobin) had damaged his apples. In his deposition, the grower admitted that he had sprayed grapes with parathion, captan, and Stop-It [a calcium supplement] prior to spraying the apples and may not have completely washed out the tank before adding Abound. The worst damage occurred with the first tank full of pesticide suggesting that the pesticides used on the grapes were responsible for the damage. However, Abound is not registered for use on apples and, therefore, must be suspected as a cause of the problem. The current label for Abound states “Abound is extremely phytotoxic to certain apple varieties. AVOID SPRAY DRIFT. Extreme care must be used to prevent injury to apple trees (and apple fruit). DO NOT spray Abound where spray drift may reach apple trees.” The reported certainty index for the apple incident (I009314-002) was categorized as “possible” for all the involved pesticides, due to the misuse of the pesticides involved. It could not be determined if an individual pesticide or some combination caused the plant damage.

5. Risk Characterization

Risk characterization is the integration of the exposure and effects characterizations to determine the potential ecological risk from varying captan use scenarios within the action area and likelihood of direct and indirect effects on the CRLF and its designated critical habitat. The risk characterization provides an estimation (Section 5.1) and a description (Section 5.2) of the likelihood of adverse effects; articulates risk assessment assumptions, limitations, and uncertainties; and synthesizes an overall conclusion regarding the likelihood of adverse effects to the CRLF and/or its designated critical habitat (i.e., “no effect,” “likely to adversely affect,” or “may affect, but not likely to adversely affect”).

5.1 Risk Estimation

Risk is estimated by calculating the ratio of exposure to toxicity. This ratio is the risk quotient (RQ), which is then compared to pre-established acute and chronic levels of concern (LOCs) for each category evaluated (**Appendix C**). For acute exposures to the CRLF and its animal prey in aquatic habitats, as well as terrestrial invertebrates, the non-listed acute risk LOC is 0.5, the non-listed acute restricted use LOC is 0.1, and the endangered species LOC is 0.05. For acute exposures to the CRLF and mammals, the non-listed acute risk LOC is 0.5, the non-listed acute restricted use LOC is 0.2, and the endangered species LOC is 0.1. The LOC for chronic exposures to CRLF and its prey, as well as acute exposures to plants is 1.0.

Risk to the aquatic-phase CRLF is estimated by calculating the ratio of exposure to toxicity using 1-in-10 year EECs based on the label-recommended captan use information summarized in **Tables 3.04 – 3.06** and the appropriate aquatic toxicity endpoint from **Table 4.02**. Risks to the terrestrial-phase CRLF and its prey (*e.g.* terrestrial insects, small mammals and terrestrial-phase frogs) are estimated based on

exposures resulting from foliar and seed applications of captan (**Tables 3.09 - 3.11**) and the appropriate toxicity endpoint from **Table 4.03**. Exposures are also derived for terrestrial plants are discussed qualitatively due to lack of data.

5.1.1 Exposures in the Aquatic Habitat

Risk quotients were calculated based on the screening level aquatic EECs for captan based on foliar spray application for the food uses, foliar spray on turf and ornamentals, and seed treatment to food and non-food uses. In cases where LOCs were not exceeded based on the maximum application rate, additional RQs were not derived because it was assumed that RQs for lower EECs would also not exceed LOCs. However, if LOCs were exceeded based on the highest EECs, use-specific RQs were also derived.

5.1.1.1. Direct Effects to Aquatic-Phase CRLF

Direct effects to the aquatic-phase CRLF are based on peak EECs in the standard pond and the lowest acute toxicity value for freshwater fish. In order to assess direct chronic risks to the CRLF, 60-day EECs and the lowest chronic toxicity value for freshwater fish are used. As shown in **Table 5.01**, acute LOCs (0.05) are exceeded for all foliar application to food uses (RQs range from 0.053 – 0.823). As a lower bound to estimated risk based on the food uses, RQs were calculated for one application to almond (crop which resulted in the highest EECs). Acute LOCs were exceeded based on one application (RQ = 0.53) and four applications (RQ = 0.823) for almond. In addition, acute LOCs were exceeded for foliar application to turf use at two applications (RQ = 0.466) and ornamentals at 26 applications (RQ = 1.09) both uses have the same application rate (4.5 lb a.i./A). The highest screening-level aquatic EEC for seed treatment for the food uses (based on use of captan on wheat at 0.169 lbs ai/A) was initially used to derive risk quotients. Acute LOCs are not exceeded for seed treatment for the food uses with the most conservative assumption of no incorporation; therefore, additional RQs were not derived because it was assumed that RQs for lower EECs would also not exceed LOCs. Acute LOCs are exceeded for grasses grown for seed (RQ = 0.155) and ornamental seedbed use (RQ = 0.597). Chronic LOCs are not exceeded for all of the proposed uses. The preliminary effects determination is “may affect”, based on direct effects to aquatic-phase CRLFs on an acute basis for foliar application of captan to food and ornamental/turf uses and non-food seed treatments.

Table 5.01. Risk Quotient values for acute and chronic exposures to Captan for Direct Effects to the CRLF (aquatic phase) based on fish toxicity.					
Uses	Application # and type	Peak EEC (µg/L)	60 day EEC (µg/L)	Direct effects Acute RQ ¹	Direct effects Chronic RQ ²
Almond (4 applications)	Aerial	21.567	0.591	0.823***	0.036
	Ground	11.995	0.219	0.458**	0.013
Almond (1 application)	Aerial	13.853	0.145	0.529***	0.009
Strawberry	Aerial	8.396	0.652	0.320**	0.040
	Ground	2.793	0.151	0.107**	0.009
Ginseng	Aerial	5.597	0.415	0.214**	0.025
	Ground	1.119	0.083	0.043	0.005
Orchard Crops					
Apple	Aerial	11.190	0.828	0.427***	0.050
	Ground	2.239	0.166	0.085*	0.010
Apricot	Aerial	6.998	0.326	0.267**	0.020
	Ground	1.400	0.065	0.053*	0.004
Cherry	Aerial	5.597	0.389	0.214**	0.024
	Ground	2.628	0.098	0.100**	0.006
Nectarine	Aerial	11.200	0.625	0.427**	0.038
	Ground	2.239	0.125	0.085*	0.008
Peach	Aerial	11.200	0.832	0.427**	0.050
	Ground	2.239	0.166	0.085*	0.010
Plum/ Prune	Aerial	8.396	0.700	0.320**	0.042
	Ground	1.679	0.400	0.064*	0.024
Vineyard Crops					
Blackberry/ Caneberry/ Raspberry/ Loganberry	Aerial	5.597	0.269	0.214**	0.016
	Ground	1.127	0.060	0.043	0.004
Blueberry	Aerial	10.166	0.634	0.388**	0.038
	Ground	5.331	0.165	0.203**	0.010
Dewberry	Aerial	8.816	0.271	0.336**	0.016
	Ground	2.317	0.075	0.088*	0.005
Grapes	Aerial	5.598	0.323	0.214**	0.020
	Ground	1.120	0.073	0.043	0.004
Seed Treatment					
Wheat	No Incorporation	0.514	0.005	0.020	<0.001
Grass/Forage/Fodder/Hays grown for seed	2 inch incorp.	4.049	0.040	0.155**	0.002
Ornamental lawn seedbed	3 inch incorp.	15.639	0.153	0.597***	0.009
Non-Food Uses					
Golf Course Turf/ Sod Farm/ Dichondra Grass	Aerial (2 appl)	12.215	0.256	0.466**	0.016
	Ground (2 appl)	3.605	0.077	0.138**	0.005
Ornamental Grasses (non-pasture areas)	Aerial (26 appl)	27.474	1.093	1.049***	0.066
	Ground (26 appl)	28.571	0.298	1.090***	0.018

¹ Based on Acute Toxicity to Brown Trout LC₅₀= 26.2 µg/L (MRID 40098001)

² Based on Chronic Toxicity to Fathead minnow NOAEC= 16.5 µg/L (MRID 00057846)

*** Exceeds Acute Risk LOC for birds (RQ≥ 0.5), in bold

** Exceeds Acute Restricted LOC for birds (RQ≥ 0.2), in bold

* Exceeds Acute Endangered Risk LOC for birds (RQ≥ 0.1), in bold

5.1.1.2 Indirect Effects to Aquatic-Phase CRLF via Reduction in Prey (non-vascular aquatic plants, aquatic invertebrates, fish, and frogs)

Non-vascular Aquatic Plants

Indirect effects of captan to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on peak EECs from the standard pond and the lowest acute toxicity value for aquatic non-vascular plants. The highest screening-level aquatic EEC for the food uses (based on use of captan on almonds at 4.5 lbs ai/A with 4 applications and 7-day intervals) and ornamental uses were initially used to derive risk quotients. Acute risk LOC ($RQ \geq 1.0$) were not exceeded based on these use patterns, therefore, additional RQs were not derived because it was assumed that RQs for lower EECs would also not exceed LOCs (**Table 5.02**). The effects determination is “no effect”, for indirect effects to aquatic-phase CRLFs based on a reduction in non-vascular aquatic plants as food items.

Table 5.02. Risk Quotient values for exposures of parent Captan to unicellular aquatic plants for Indirect Effects (diet of CRLF in tadpole life stage)			
Uses	Application # and type	Peak EEC (µg/L)	Indirect effects Non-endangered RQ ¹
Almond	Aerial	21.567	0.067
	Ground	11.995	0.037
Non-Food Uses			
Golf Course Turf/ Sod Farm	Aerial (2 applications)	12.215	0.038
	Ground (2 applications)	3.605	0.011
Ornamental Grasses (non-pasture areas)	Aerial (26 appl)	27.474	0.086
	Ground (26 appl)	28.571	0.089

¹ Based on green algae (*Scenedesmus subspicatus*) $EC_{50} = 320 \mu\text{g/L}$ (ACC 252586)

+ Exceeds Non-endangered Aquatic Plant LOC (1.0)

Aquatic Invertebrates

Indirect acute effects to the aquatic-phase CRLF via effects to prey (invertebrates) in aquatic habitats are based on peak EECs in the standard pond and the lowest acute toxicity value for freshwater invertebrates. For chronic risks, 21-day EECs and the lowest chronic toxicity value for invertebrates are used to derive RQs. The highest screening-level aquatic EEC for the food uses (based on use of captan on almonds at 4.5 lbs ai/A with 4 applications and 7-day intervals) was initially used to derive risk quotients. Acute and chronic risk LOCs were not exceeded based on this use pattern, therefore, additional RQs were not derived (including seed treatment) because it was assumed that RQs for lower EECs would also not exceed LOCs. In addition, acute and chronic LOCs were not exceeded for all modeled ornamental and turf non-food uses. A summary of the acute and chronic RQ values for exposure to aquatic invertebrates (as prey items of aquatic-phase CRLFs) is provided in **Table 5.03**. The effects determination is “no effect” for indirect effects to aquatic-phase CRLFs based on a reduction of freshwater invertebrates as prey (via direct acute toxicity to freshwater invertebrates) for all modeled uses.

Table 5.03. Risk Quotient values for exposures of parent Captan to Aquatic Invertebrates (Daphnid) for Indirect Effects (prey-base of CRLF)					
Uses	Application # and type	Peak EEC (µg/L)	21 day EEC (µg/L)	Indirect effect Acute RQ	Indirect effect Chronic RQ
Almond	Aerial	21.567	1.552	0.003	0.002
	Ground	11.995	0.640	0.001	0.001
Non-Food Uses					
Golf Course Turf/ Sod Farm	Aerial (2 appl)	12.215	0.732	0.001	0.001
	Ground (2 appl)	3.605	0.220	<0.001	<0.001
Ornamental Grasses (non-pasture areas)	Aerial (26 appl)	27.474	1.194	0.003	0.002
	Ground (26 appl)	28.571	0.761	0.003	0.001

¹ Based on Acute Toxicity to Daphnid EC₅₀= 8400 µg/L (MRID GS0120041)

² Based on Chronic Toxicity to Daphnia NOAEC= 560 µg/L (MRID 441488-01)

Fish and Frogs

Fish and frogs also represent prey of the CRLF. RQs associated with acute and chronic direct toxicity to the CRLF (**Table 5.01**) are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items. Given that acute RQs for direct toxicity to the CRLF exceed non-listed acute risk LOCs, the preliminary effects determination is “may affect”, based on indirect effects as a reduction of fish and frogs as prey items for foliar application of captan to food and ornamental/turf uses.

5.1.1.3. Indirect Effects to CRLF via Reduction in Habitat and/or Primary Productivity (Freshwater Aquatic Plants)

Indirect effects to the CRLF via direct toxicity to aquatic plants are estimated using the most sensitive non-vascular and vascular plant toxicity endpoints. Because there are no obligate relationships between the CRLF and any aquatic plant species, the most sensitive EC₅₀ values, rather than NOAEC values, were used to derive RQs. As shown in **Table 5.04**, none of the RQs exceed the LOC of 1 for vascular aquatic plants. In addition, as previously discussed in Section 5.1.1.2 and summarized in Table 5.02, LOCs are not exceeded for non-vascular aquatic plants for all captan uses. Therefore, the preliminary effects determination is “no effect”, based on indirect effects to habitat and/or primary productivity for the aquatic-phase CRLF for use of captan.

Table 5.04. Risk Quotient values for exposures of parent Captan to vascular aquatic plants for Indirect Effects (habitat of aquatic-phase CRLF)			
Uses	Application # and type	Peak EEC (µg/L)	Indirect effects Non-endangered RQ ¹
Almond	Aerial	21.567	<0.002
	Ground	11.995	<0.001
Non-Food Uses			
Golf Course Turf/ Sod Farm	Aerial (2 applications)	12.215	<0.001
	Ground (2 applications)	3.605	<0.001
Ornamental Grasses (non-pasture areas)	Aerial (26 applications)	27.474	0.002
	Ground (26 applications)	28.571	0.002

¹ Based on duckweed (*Lemna gibba*) EC₅₀ > 12,700 µg/L (MRID 448065-03)

+ Exceeds Non-endangered Aquatic Plant LOC (1.0)

5.1.2 Exposures in the Terrestrial Habitat

5.1.2.1 Direct Effects to Terrestrial-phase CRLF

To assess risks of captan to terrestrial-phase CRLF, dietary-based and dose-based exposures modeled in T-REX for a small bird (20 g) and medium (100 g) bird, which are used as a surrogate for juvenile and adult terrestrial-phase amphibians, respectively, are used. Exposure is based on the consumption of small insects. Acute, subacute and chronic effects are estimated using the lowest available toxicity data for birds. EECs are divided by toxicity values to estimate acute and chronic dietary-based RQs as well as dose-based RQs.

Acute dose and dietary-based RQ values, and chronic dietary-based RQ values exceed the LOC for the frog for all uses based on the screening level estimate using T-REX, however these RQs are non-definitive and represent an upper bound of the risk (**Table 5.05**). Definitive acute RQ values for terrestrial-phase CRLFs could not be derived because the acute avian effects data show no mortality to the mallard duck ($LD_{50} > 2,000$ mg/kg bw) and the Northern bobwhite quail duck ($LD_{50} > 2,150$ mg/kg bw). Although definitive dose-based RQs cannot be determined, upper bound RQs were estimated. The predicted acute dose-based EECs (2655 – 4033 ppm based on use on peach) are about four times the adjusted LD_{50} values for juvenile terrestrial-phase CRLFs (1038 mg/kg-bw).

In addition, the dietary-based LC_{50} value for the mallard duck, Japanese quail, and ring-necked pheasant ($LC_{50} > 5,000$ mg/kg diet) and Northern bobwhite quail ($LC_{50} > 2,400$ mg/kg bw) also indicates no mortality at the highest test concentration. The predicted acute dietary-based EECs (2331 – 3542 ppm) also exceed the 2400 mg/kg diet (dietary) test levels. However, the dietary EECs do not exceed the LC_{50} value for the mallard duck, Japanese quail, and ring-necked pheasant ($LC_{50} > 5,000$ mg/kg diet).

The mallard duck and bobwhite quail reproduction studies indicate that exposure at the three test concentrations of 100, 300, and 1000 mg/kg diet did not affect reproduction ($NOAEC > 1000$ mg/kg diet). The predicted dietary-based EECs (2331 – 3542 ppm) also exceed these test levels. Effects to birds, and therefore terrestrial-phase CRLF, are unknown at such increased exposure levels. Thus, the RQs calculated based on these endpoints are an upper bound estimate. RQs for a definitive endpoint would be lower, but how much lower cannot be determined from this study.

Table 5.05. Acute and chronic, dietary-based RQs and dose-based RQs based on T-REX for direct effects to the terrestrial-phase CRLF (RQs bracketed between foliar dissipation half lives of 10 and 35 days).¹

Use	Acute Dose -Based RQ (food - small insects)		Acute Dietary-based RQ Small Insects	Chronic Dietary - Based RQ Small Insects
	20 g birds	100 g birds		
Caneberry	<0.57 – <1.04***	<0.26 – <0.46**	<0.22 – <0.39 **	<0.52 – <0.94
Peach	<2.56 – <3.88***	<1.15 – <1.74***	<0.97 – <1.48 ***	<2.33 – <3.54 +
Wheat	<0.30**	--	--	<1.25 +
Golf Course Turf/ Sod Farm/ Dichondra grasses	<1.03 – <1.19 ***	<0.46 – <0.53***	<0.39 – <0.45 **	<0.94 – <1.09 +
Ornamental grasses	<1.66 – <4.78 ***	<0.74 – <2.14***	<0.63 – <1.82 ***	<1.51 – <4.36 +

¹ Avian toxicity tests used to evaluate the terrestrial phase frog did not establish a definitive endpoint (*i.e.*, the value was greater than the highest concentration tested), thus these RQ values represent an upper bound

*** Exceeds Acute Risk LOC for birds (RQ ≥ 0.5)

** Exceeds Acute Restricted LOC for birds (RQ ≥ 0.2)

* Exceeds Acute Endangered Risk LOC for birds (RQ ≥ 0.1)

+ Exceeds Chronic Risk LOC for birds (RQ ≥ 1.0)

Because RQs for the surrogate for terrestrial phase frogs exceeded the LOCs for all application rates, the T-HERPS model was used to better evaluate potential dose-based risk. T-HERPS is a modification of T-REX which includes amphibian/reptile specific allometric equations, weight classes appropriate for the CLRF, and prey items specific to the CLRF. T-HERP groups the frogs into three classes: small (1.4g), medium (37g), and large (238g). The two smaller weight classes most closely approximate the 20g juvenile that exceeded LOCs using the T-REX model.

Based on T-HERPS, the refined dose-based RQs do not exceed the endangered species acute risk LOCs for all of the frog weight classes consuming insects. Acute dose-based LOCs are exceeded for direct effects for large frogs (238 grams) consuming small herbivorous mammals based on captan use on peaches (upper bound) (**Table 5.06**).

Because acute dietary-based and chronic LOCs are exceeded for the frogs, the preliminary effects determination for direct acute effects to the terrestrial-phase CRLF is “may affect”.

Table 5.06. Refined acute dose-based RQs for direct effects to the terrestrial-phase CRLF, based on 10-day foliar dissipation half-life, calculated using T-HERPS. ¹

Food	Dose Based RQ 1.4 g CRLF		Dose Based RQ 37 g CRLF		Dose Based RQ 238 g CRLF	
	Caneberry	Peach	Caneberry	Peach	Caneberry	Peach
Small Insects	<0.01	<0.05	<0.01	<0.04	<0.01	<0.03
Large Insects	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Small Herbivore mammals	NA		NA		<0.05	<0.20**
Small Insectivore mammals	NA		NA		<0.01	<0.01
Small Terrestrial-phase Amphibians	NA		NA		<0.01	<0.01

¹ Avian toxicity tests used to evaluate the terrestrial phase frog did not establish a definitive endpoint (*i.e.*, the value was greater than the highest concentration tested), thus these RQ values represent an upper bound

** Exceeds Acute Restricted LOC and Acute Endangered Risk for birds ($RQ \geq 0.2$), in bold

NA Not Applicable (size class of frog too small to consume mammals and amphibians)

5.1.2.2. Indirect Effects to Terrestrial-Phase CRLF via Reduction in Prey (terrestrial invertebrates, mammals, and frogs)

5.1.2.2.1 Terrestrial Invertebrates

In order to assess the risks of foliar applications of captan to terrestrial invertebrates, which are considered prey of CRLF in terrestrial habitats, the blue orchard bee (*Osmia lignaria*) was used as a surrogate for terrestrial invertebrates. The acute contact $LD_{50} = 270 \mu\text{g a.i./bee}$ (*Osmia lignaria*) was converted to ppm units using the weight of an adult honey bee (1 bee/0.128g) resulting in $LD_{50} = 2107 \mu\text{g a.i./g of bee}$. Female orchard bees were used in the acute contact toxicity study which are approximately the same size as the honey bee (Bosch and Kemp, 2001). EECs (in ppm which is equal to $\mu\text{g a.i./g of bee}$) were calculated in T-REX and based on residues on small and large insects. The resulting RQ values for large insect and small insect exposures bound the potential range of exposures for terrestrial insects to captan. The RQ values exceed the LOC ($RQ \geq 0.05$) for both large and small terrestrial insects for all uses (**Table 5.07**). The preliminary effects determination for indirect effects to terrestrial-phase CRLFs via reduction in terrestrial invertebrates as dietary food items is “may affect”.

Table 5.07. Summary of RQs Used to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Terrestrial Invertebrates as Dietary Food Items (RQs bracketed by foliar dissipation half-lives 10 - 35 days)

Use	Small Insect RQ	Large Insect RQ
Caneberry (Lowest food use)	0.25 – 0.45 *	0.03 – 0.05 *
Peach (Highest food use)	1.11 – 1.68 *	0.123 – 0.187 *
Golf Course Turf/ Sod Farm/ Dichondra grasses (4.3 lb a.i./A, 2 appl, 7-day)	0.45 – 0.52 *	0.05 – 0.06 *
Ornamental grasses (4.3 lb a.i./A, 26 appl, 7-day)	0.72 – 2.07 *	0.08 – 0.23 *

* Exceeds terrestrial insect LOC ($RQ \geq 0.05$)

5.1.2.2.2a Mammals

Risks associated with ingestion of small mammals by large terrestrial-phase CRLFs are derived for dietary-based and dose-based exposures modeled in T-REX for a small mammal (15g) consuming short grass. EECs are divided by the toxicity value to estimate acute and chronic dose-based RQs as well as chronic dietary-based RQs. Indirect effects to terrestrial-phase CRLFs via direct acute effects to small mammals as prey items are evaluated using the acute toxicity data ($LD_{50} = 9,000$ mg/kg/diet, MRID 00054789). For this assessment, the chronic three-generation reproduction toxicity endpoint (NOAEL = 250 mg a.i./kg diet) for the laboratory rat was used for estimating chronic effects from captan exposure. Results of the study showed decreases in the mean litter weights of pups and severe sexual organ atrophy in adults and pups.

Risk quotients were calculated for the food use with the lowest application rate (caneberry) and the highest application rate (peach). Risk quotients were calculated based on both a 10-day and 35-day foliar dissipation half-life. Acute dose-based, acute dietary-based and chronic dietary based LOCs were exceeded for all foliar applications (**Table 5.08**). Acute LOCs were not exceeded for captan applied as a seed treatment. The preliminary effects determination for indirect effects to terrestrial-phase CRLFs via reduction in small mammals as dietary food items is “may affect”.

Table 5.08. Summary of Acute¹ and Chronic² RQs to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Small Mammals as Dietary Food Items. RQs bracketed by foliar dissipation half-lives 10 - 35 days.

Use (Application Rate)	Dose-based Acute RQ ¹	Dose-based Chronic RQ ²	Dietary-based Chronic RQ ²
Caneberry (Lowest food use)	0.04 – 0.08	32.27 – 58.27 +	3.72 – 6.72 +
Peach (Highest food use)	0.20 - 0.30 **	144 - 219 +	16.58 – 25.18 +
Wheat – Seed Treatment	0.01		5.00 +
Golf Course Turf/ Sod Farm/ Dichondra grasses (4.3 lb a.i./A, 2 appl, 7-day)	0.08 - 0.09	57.86 – 66.99 +	6.67 – 7.72 +
Ornamental grasses (4.3 lb a.i./A, 26 appl, 7-day)	0.13* – 0.37 **	93.16 – 269 +	10.74 – 31.02 +

* Exceeds Acute Risk mammalian LOC (RQ ≥ 0.1)

** Exceeds Acute Restricted Risk mammalian LOC (RQ ≥ 0.2)

+ Exceeds mammalian chronic LOC (RQ ≥ 1)

¹ Based on dose-based EEC and rat LD₅₀ = 9000 mg/kg-diet (MRID 00054789)

² Based on dietary-based EEC and rat NOAEC = 250 mg/kg-diet (MRID 00125293)

5.1.2.2.3 Frogs

An additional prey item of the adult terrestrial-phase CRLF is other species of frogs. In order to assess risks to these organisms, dietary-based and dose-based exposures modeled in T-REX for a small bird (20g) consuming small invertebrates are used. As previously discussed in Section 5.1.2.1, direct acute effects to frogs are possible but the risk quotients are non-definitive, based on the available avian acute toxicity data. Acute and chronic RQ values exceed the LOC for all modeled uses of captan (**Table 5.05**). Therefore, the preliminary effects determination for indirect effects to terrestrial-phase CRLFs via reduction in other species of frogs as dietary food items is “may affect”.

5.1.2.3. Indirect Effects to CRLF via Reduction in Terrestrial Plant Community (Riparian and Upland Habitat)

Potential indirect effects to the CRLF resulting from direct effects on riparian and upland vegetation are typically assessed using RQs from terrestrial plant seedling emergence and vegetative vigor EC₂₅ data as a screen. No guideline terrestrial plant toxicity data for captan were submitted to the Agency. Using open literature studies obtained from ECOTOX, it was not possible to determine endpoints analogous to the seedling emergence or vegetative vigor EC₂₅. No RQ calculations were performed; however, EECs were calculated for the highest single foliar application rate of 4.5 lbs ai/acre using TERRPLANT (Appendix K). EECs for spray drift alone, total for dry areas, total for semi-aquatic areas are 0.23, 0.27, and 0.68 lbs ai/acre.

Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species (Section 4.2.4). Application rates were provided in lbs ai/cwt-seed; exposure estimation in units suitable for TERRPLANT (i.e., lbs ai/acre) could not be determined for any of these studies. Individual seed exposure to captan was high as seeds were coated with captan by shaking seeds and pesticide in a closed container. This exposure is likely to be higher than

expected exposure due to spray drift and runoff after application in the field. None of the reviewed papers reported any negative effects of captan on germination or growth of seedlings. The results of these studies were considered qualitatively in lieu of a seedling emergence study.

Based on ECOTOX data, there is the potential that terrestrial plants may be impacted by foliar application of captan. In one study (#63909), highbush blueberries showed mild phytotoxic effects at an application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush blueberries fall in the species sensitivity distribution for dicots or terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. However, the EECs estimated by TERRPLANT (0.23 – 0.68 lb a.i./A) are much less than the exposure causing mild phytotoxic effects to blueberries in the study.

The preliminary effects determination for indirect effects to terrestrial- and aquatic-phase CRLFs via reduction in the terrestrial plant community is “may affect”.

5.1.3 Primary Constituent Elements of Designated Critical Habitat

5.1.3.1 Aquatic-Phase (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

The preliminary effects determination for aquatic-phase PCEs of designated habitat related to potential effects on aquatic plants is “no effect”, based on the risk estimation provided for aquatic vascular and non-vascular plants described in Sections 5.1.1.2 and 5.1.1.3. The preliminary effects determination for aquatic-phase PCEs of designated habitat related to potential effects on terrestrial plants is “may affect”, based on the risk estimation described in Sections 5.1.1.2 and 5.1.2.3.

The remaining aquatic-phase PCE is “alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.” To assess

the impact of captan on this PCE, acute and chronic freshwater fish and invertebrate toxicity endpoints, as well endpoints for aquatic non-vascular plants, are used as measures of effects. RQs for these endpoints were calculated in Sections 5.1.1.1 and 5.1.1.2. Based on these results, the preliminary effects determination for alteration of characteristics necessary for normal growth and viability of the CRLF is “may affect” (see Section 5.1.1.1). However, aquatic invertebrate and non-vascular aquatic plant food items of the CRLF are not affected; therefore the preliminary effects determination for potential impacts to these food items is “no effect” (see Section 5.1.1.2).

5.1.3.2 Terrestrial-Phase (Upland Habitat and Dispersal Habitat)

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance
- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal

The preliminary effects determination for terrestrial-phase PCEs of designated habitat related to potential effects on terrestrial plants is “may affect”, based on the risk estimation provided in Section 5.1.2.3.

The third terrestrial-phase PCE is “reduction and/or modification of food sources for terrestrial phase juveniles and adults.” To assess the impact of captan on this PCE, acute and chronic toxicity endpoints for birds, mammals, and terrestrial invertebrates are used as measures of effects. RQs for these endpoints, which were calculated in Section 5.1.2.2, exceed the LOCs for all captan uses. Captan is expected to cause direct effects to terrestrial invertebrate and frog prey items of the terrestrial-phase CRLF. The preliminary effects determination for adverse habitat modification via impacts of captan uses to terrestrial-phase CRLF food items is “may affect”.

The fourth terrestrial-phase PC is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. Direct acute effects, via mortality, may be affected for the terrestrial-phase CRLF (see Section 5.2.1.2). Therefore the preliminary effects determinations for adverse habitat modification is “may affect” via direct acute effects to terrestrial-phase CRLFs.

5.1.4 Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The use map (**Figure 7**) shows the extent of orchard/vineyard, agricultural (including ornamentals), and turf land cover which represent the labeled uses for captan in California. The initial area of concern is defined as the land cover types and the initial stream reaches (**Figure 8**). The screening level risk assessment will define which taxa, if any, are predicted to be exposed at concentrations above the Agency's Levels of Concern (LOC). LOC exceedances are used to describe how far effects may be seen from the initial area of concern. The final action area includes the terrestrial action based on the buffered area from the spray drift analysis and the aquatic action area based on the downstream extent (**Figure 9**).

5.1.4.1. Downstream Aquatic Areas affected by the federal action

In order to determine the extent of the action area in aquatic habitats, the agricultural (including ornamentals), orchard/vineyard, and turf uses resulting in the greatest ratios of the RQ to the LOC for any endpoint for aquatic organisms is used to determine the distance downstream for concentrations to be diluted below levels that would be of concern (*i.e.* result in RQs above the LOC). The downstream dilution for all uses is based on direct effects to the CRLF through acute effects to fish (LOC = 0.05) exposed to captan in runoff. Downstream analysis for the agriculture land use type is based on ornamental grasses at 4.3 lb a.i./A with 26 applications with a 7-day interval (RQ = 1.09) because it has the greatest ratio of 21.80. Downstream analysis for the orchard/vineyard land use type is based on almond at 4.5 lb a.i./A with 4 applications with a 7-day interval (RQ = 0.823) because it has the greatest ratio of 16.46. Downstream analysis for the turf land use type is based on golf courses at 4.3 lb a.i./A with 2 applications with a 7-day interval (RQ = 0.466) because it has the greatest ratio of 9.32. The areas indirectly affected by the federal action due to runoff of captan to aquatic habitats are depicted in **Figure 9 (Section 2.7)**. The total stream kilometers within the action area that are at levels of concern are defined in **Table 5.09**.

Table 5.09. Aquatic spatial summary results for agricultural (including ornamentals), orchard/vineyard and turf land use types.			
Measure	Agriculture	Orchard/Vineyard	Turf
Total California stream kilometers	332,962		
Total stream kilometers in initial area of concern	57,087	11,946	19,939
Total stream kilometers added downstream	3,580	1,477	765
Total stream kilometers in final action area	60,667	13,423	20,704

5.1.4.2. Terrestrial Areas affected by the federal action

When considering the terrestrial habitats of the CRLF, spray drift from use sites onto non-target areas could potentially result in exposures of the CRLF, its prey and its habitat to captan. Therefore, it is necessary to estimate the distance from the application site where spray drift exposures do not result in LOC exceedances for organisms within the terrestrial habitat.

Since spray drift is the most likely means through which non-target terrestrial organisms will be potentially exposed to captan, the AGDISP model (version 8.13) is used to estimate the terrestrial distance from the site of application to where RQs are predicted to fall below the endangered species LOC as described in Section 3.2.3. The highest single maximum application rate allowed on the label for captan uses was modeled to determine the maximum potential off-site estimated environmental concentrations (EECs) for a single application based on upper bound Kenaga values. The highest single maximum application rate was determined for each land use type including agriculture (includes ornamentals), orchard/ vineyard and turf. Almond is the orchard/vineyard crop with the highest application rate with a single application of 4.5 lb a.i./acre. Ornamental grasses is the agriculture crop with the highest application rate with a single application of 4.3 lb a.i./acre. Turf has the same single application of 4.3 lb a.i./acre as ornamental grasses.

Chronic effects to terrestrial mammals are used to establish a boundary around a treatment site beyond which potential effects to terrestrial species from captan use are not expected. This taxa is chosen because it has the highest RQ/LOC ratio. In order to estimate the terrestrial distance from the site of application to where RQs are predicted to fall below the LOC, the deposition must be estimated. The initial average deposition is calculated by multiplying the fraction of captan applied by the application rate. The fraction of captan applied is ratio of LOC/RQ. The ratio of the LOC (1.0) for chronic effects to mammals to the RQ (37.48) for almonds is 0.0267.

The resulting terrestrial action area buffer based on terrestrial mammals is 1001 ft for the maximum single application rate for almond. This buffer was applied to the orchard/vineyard, agriculture and turf land use types. Therefore, the terrestrial portion of the captan action area for this assessment includes all potential orchard/vineyard, agricultural and turf use sites and all areas that are within 1001 ft of potential captan use sites in CA.

5.1.4.3. Final action area

In order to define the final action areas relevant to uses of captan on agricultural and orchard crops, it is necessary to combine the terrestrial and aquatic areas affected by the federal action. The initial footprint of the agricultural and orchard land cover use areas have been expanded to include aquatic and terrestrial non-target areas affected by run-off (determined by downstream dilution modeling) and spray drift (determined by spray drift modeling). It is assumed that lentic (standing water) aquatic habitats (*e.g.* ponds, pools,

marshes) in with the terrestrial areas are also affected by the federal action. The result is a final action area for captan uses in agricultural, orchard/ vineyard and turf areas (**Figure 9**).

As indicated above, agricultural, orchard, and turf uses of captan could result in deposition of captan from the atmosphere which could reach areas outside of the defined action areas for these uses. However, since volatilization is low for captan, atmospheric transport and deposition are not expected to play an important role in captan transport.

5.1.4.4. Overlap between CRLF habitat and final action area

In order to confirm that uses of captan have the potential to affect CRLF through direct applications to target areas and runoff and spray drift to non-target areas, it is necessary to determine whether or not the final action areas for agricultural and orchard crops and turf use of captan overlap with CRLF habitats. Spatial analysis using ArcGIS 9.1 indicates that lotic aquatic habitats within the CRLF core areas and critical habitats potentially contain concentrations of captan sufficient to result in RQ values that exceed LOCs. In addition, terrestrial habitats (and potentially lentic aquatic habitats) of the final action areas for agricultural, ornamental, and turf uses of captan overlap with the core areas, critical habitat and available occurrence data for CRLF (**Figure 14**). Based on this analysis, a total of 2,442 km² (9%) of the CRLF range overlaps with the terrestrial portion of the captan action area for agriculture and orchard uses and 1,659 km² (6%) of the CRLF range overlaps for turf use alone. There are 327 sections (34%) of established occurrence sections of the CRLF that overlap with the terrestrial portion of the captan action area for agriculture and orchard uses. There are 232 sections (25%) of established occurrence sections of the CRLF that overlap for turf uses. The percentage of land overlap of the terrestrial action with the CRLF habitat and the number of occurrence sections was determined for each recovery unit (**Table 5.10**). Thus, uses of captan on agricultural and orchard crops and turf use could result in exposures of captan to CRLF in aquatic and terrestrial habitats. Additional analysis related to the intersection of the captan action area and CRLF habitat for each recovery unit is described in **Appendix E**.

Table 5.10. Summary of captan terrestrial action area that overlaps with CLRF habitat range by recovery unit (RU).									
Measure	RU1	RU2	RU3	RU4	RU5	RU6	RU7	RU8	Total
Units = km ²									
Agriculture and Orchard/ Vineyard Uses									
Established species range area (sq km)	3654	2742	1323	3279	3650	5306	4917	3326	28,197
Overlapping area (sq km)	39	75.7	47	137	432	616	796	298	2,442
<i>Percent area affected</i>	<i>1%</i>	<i>3%</i>	<i>4%</i>	<i>4%</i>	<i>12%</i>	<i>12%</i>	<i>16%</i>	<i>9%</i>	<i>9%</i>
Established occurrence sections (959 total; 30 outside recovery units)	13	3	70	324	276	120	90	33	929
# Occurrence sections affected	0	0	8	75	155	30	59	0	327
Turf Use									
Overlapping area (sq km)	56	56	62	528	275	175	239	266	1659
<i>Percent area affected</i>	<i>2%</i>	<i>2%</i>	<i>5%</i>	<i>16%</i>	<i>8%</i>	<i>3%</i>	<i>5%</i>	<i>8%</i>	<i>6%</i>
# Occurrence sections affected	1	0	15	86	78	14	37	1	232

Captan - Action Area and CRLF Habitat

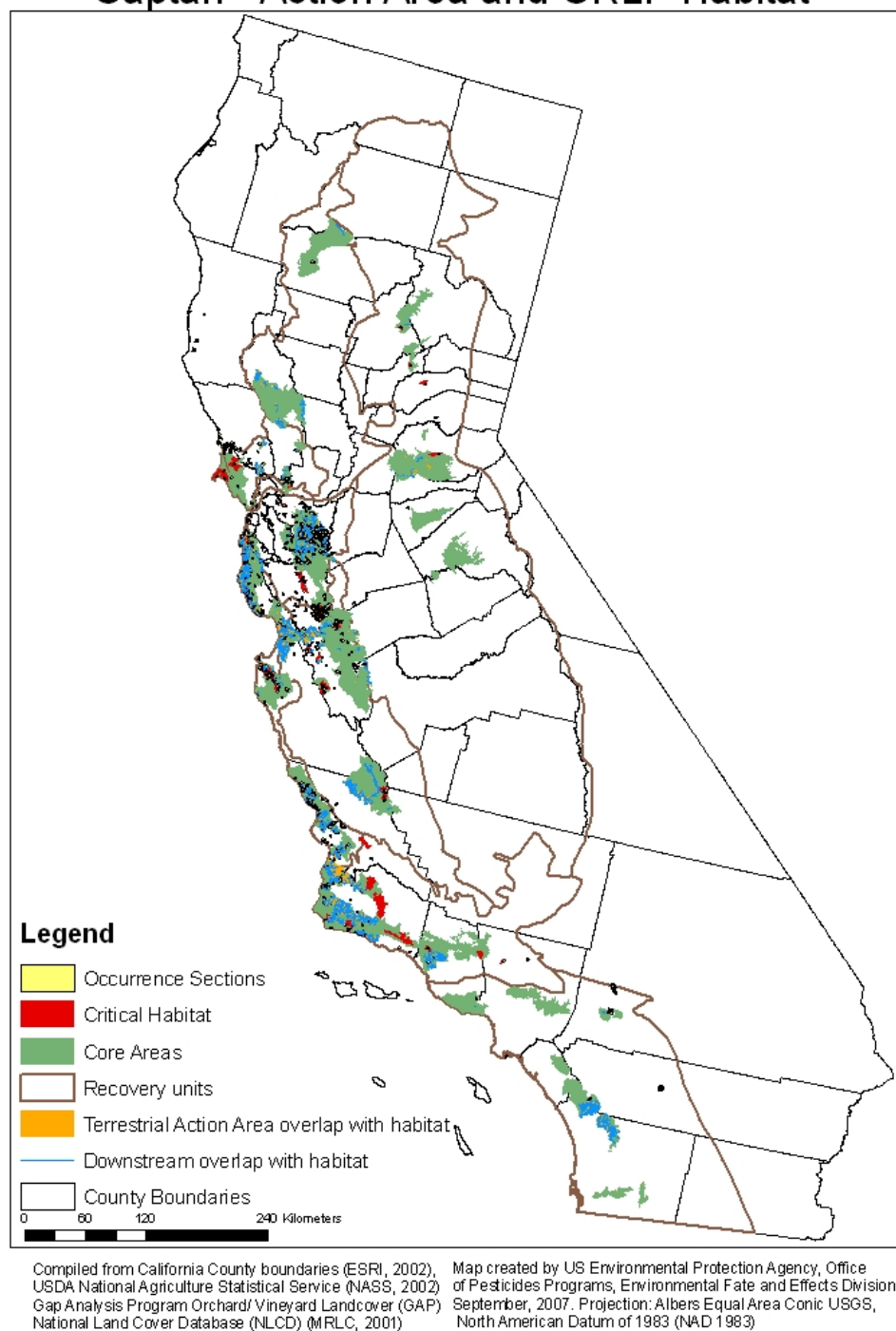


Figure 14. Map showing the areas of overlap between the terrestrial and aquatic action area and the CRLF habitat

5.2 Risk Description

The risk description synthesizes an overall conclusion regarding the likelihood of adverse impacts leading to an effects determination (*i.e.*, “no effect,” “may affect, but not likely to adversely affect,” or “likely to adversely affect”) for the CRLF and its designated critical habitat.

If the RQs presented in the Risk Estimation (Section 5.1) show no direct or indirect effects for the CRLF, and no modification to PCEs of the CRLF’s designated critical habitat, a “no effect” determination is made, based on captan’s use within the action area. However, if direct or indirect effect LOCs are exceeded and/or effects may modify the PCEs of the CRLF’s critical habitat, the Agency concludes a preliminary “may affect” determination for the FIFRA regulatory action regarding captan. A summary of the results of the risk estimation (*i.e.*, “no effect” or “may affect” finding) is provided in **Table 5.11** for direct and indirect effects to the CRLF and in **Table 5.12** for the PCEs of designated critical habitat for the CRLF.

Table 5.11. Preliminary Effects Determination Summary for Captan - Direct and Indirect Effects to CRLF

Assessment Endpoint	Preliminary Effects Determination	Basis For Preliminary Determination
<i>Aquatic Phase</i> <i>(eggs, larvae, tadpoles, juveniles, and adults)</i>		
Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	May affect	Using freshwater fish as a surrogate, non-listed acute risk LOCs are exceeded, chronic LOCs are not exceeded (Table 5.01).
Survival, growth, and reproduction of CRLF individuals via effects to food supply (<i>i.e.</i> , freshwater invertebrates, non-vascular plants, fish and frogs)	No effect	Acute freshwater invertebrate RQs do not exceed acute or chronic LOCs (Tables 5.03). Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02).
	May affect	Non-listed acute risk LOCs are exceeded based on the most sensitive toxicity data for freshwater fish, using fish as a surrogate for frogs (Table 5.01).
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, and/or primary productivity (<i>i.e.</i> , aquatic plant community)	No effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02). Aquatic vascular plant LOCs are not exceeded for applications of captan to all uses (Table 5.04).
Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	May affect	RQs were not calculated for terrestrial plants due to lack of appropriate data. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush blueberries fall in the species sensitivity distribution for dicots or for terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. Due to the high level of uncertainty, a "may affect" determination was made.
<i>Terrestrial Phase</i> <i>(Juveniles and adults)</i>		
Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	May affect	Based on the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, no mortality was reported at the highest test concentrations of captan. However, predicted EECs, are greater than reported acute avian toxicity values and upper-bound RQ values exceed avian acute and chronic LOCs for all uses (Table 5.05).
Survival, growth, and reproduction of CRLF individuals via effects on prey (<i>i.e.</i> , terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	May affect	Acute and chronic RQs for mammals and birds exceed the LOCs. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05 – 5.09).
Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (<i>i.e.</i> , riparian vegetation)	May affect	RQs were not calculated for terrestrial plants due to lack of appropriate data. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an

		application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush blueberries fall in the species sensitivity distribution for dicots or for terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. Due to the high level of uncertainty, a “may affect” determination was made.
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Table 5.12. Preliminary Effects Determination Summary for Captan – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Preliminary Effects Determination	Basis For Preliminary Determination
<i>Aquatic Phase PCEs</i> <i>(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)</i>		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	May affect	RQs were not calculated for terrestrial plants due to lack of appropriate data. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush blueberries fall in the species sensitivity distribution for dicots or for terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. Due to the high level of uncertainty, a “may affect” determination was made.
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	May affect	
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	<u>Growth and viability of CRLF:</u> May affect	Using freshwater fish as a surrogate, acute LOCs are exceeded for all uses (Table 5.01).
	<u>Food source:</u> No effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02). Aquatic vascular plant LOCs are not exceeded for applications of captan to all uses (Table 5.04).
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	No effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02).
<i>Terrestrial Phase PCEs</i> <i>(Upland Habitat and Dispersal Habitat)</i>		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	May affect	RQs were not calculated for terrestrial plants due to lack of appropriate data. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush

Table 5.12. Preliminary Effects Determination Summary for Captan – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Preliminary Effects Determination	Basis For Preliminary Determination
		blueberries fall in the species sensitivity distribution for dicots or for terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. Due to the high level of uncertainty, a “may affect” determination was made.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	May affect	RQs were not calculated for terrestrial plants due to lack of appropriate data. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush blueberries fall in the species sensitivity distribution for dicots or for terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. Due to the high level of uncertainty, a “may affect” determination was made.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	May affect	Acute and chronic RQs for mammals and birds exceed the LOCs for all modeled uses of captan. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05 – 5.09).
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	May affect	Acute and chronic RQs for mammals and birds exceed the LOCs for all modeled uses of captan. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05 – 5.09).

Following a “may affect” determination, additional information is considered to refine the potential for exposure at the predicted levels based on the life history characteristics (*i.e.*, habitat range, feeding preferences, etc.) of the CRLF. Based on the best available information, the Agency uses the refined evaluation to distinguish those actions that “may affect, but are not likely to adversely affect” from those actions that are “likely to adversely affect” the CRLF and its designated critical habitat.

The criteria used to make determinations that the effects of an action are “not likely to adversely affect” the CRLF and its designated critical habitat include the following:

- Significance of Effect: Insignificant effects are those that cannot be meaningfully measured, detected, or evaluated in the context of a level of effect where “take”

occurs for even a single individual. “Take” in this context means to harass or harm, defined as the following:

- Harm includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.
- Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.
- Likelihood of the Effect Occurring: Discountable effects are those that are extremely unlikely to occur. For example, use of dose-response information to estimate the likelihood of effects can inform the evaluation of some discountable effects.
 - Adverse Nature of Effect: Effects that are wholly beneficial without any adverse effects are not considered adverse.

A description of the risk and effects determination for each of the established assessment endpoints for the CRLF and its designated critical habitat is provided in **Sections 5.2.1 through 5.2.3**.

5.2.1 Direct Effects

5.2.1.1 Aquatic-Phase CRLF

The aquatic-phase considers life stages of the frog that are obligatory aquatic organisms, including eggs, larvae, and tadpoles. It also considers submerged terrestrial-phase juveniles and adults, which spend a portion of their time in water bodies that may receive runoff and spray drift containing captan. As shown in Table 5.01, acute LOCs are exceeded for all captan uses based on the highest modeled EECs and the most sensitive freshwater fish data (used as a surrogate for aquatic-phase amphibians). Chronic LOCs are not exceeded based on all captan uses.

The RQs for direct effects to the frog are based on maximum label rates. Surface water monitoring data accessed from the California Department of Pesticide Regulation program found no detectable levels of captan at monitoring sites in Monterey and Santa Cruz counties, however this sampling only occurred on one day and is not sufficient from which to draw conclusions. Captan data are not included in the available NAWQA surface water monitoring data from California. The use of modeled EECs is assumed to provide a conservative measure of captan exposures for aquatic-phase CRLFs.

Ecotoxicity data for freshwater fish are generally used as surrogates for aquatic-phase amphibians when amphibian toxicity data are not available (U.S. EPA, 2004). Some amphibian data were located in ECOTOX. Toxicity data for two species (ECOTOX #90515), the African clawed frog (*Xenopus laevis*, $LC_{50} = 119.4 \mu\text{g/L}$ in mineral water) and the Spanish ribbed newt (*Pleurodeles waltl*, $LC_{50} = 311.1 \mu\text{g/L}$ in mineral water) indicated that mortality effects for amphibians occur in concentrations similar to lethal

endpoints for fish, which serve as a surrogate for aquatic phase amphibians. The results of this study are based on nominal concentrations because measured concentrations were not taken. In addition, turbidity was observed in the reconstituted water treatments; therefore, there are uncertainties associated with the results of this study. Thus EFED used the toxicity value from the fish data to calculate RQs.

The RQs for direct effects to the frog are based on the most sensitive freshwater fish data (used as a surrogate for aquatic-phase amphibians). The brown trout was found to be the most sensitive freshwater fish test species ($LC_{50} = 26.2 \mu\text{g/L}$, MRID 40098001). Captan is highly toxic to very highly toxic to freshwater fish ($LC_{50}s = 26.2 - 137 \mu\text{g/L}$) on an acute basis. The toxicity of captan to several fish species is similar as shown in the fish species sensitivity distribution below (Figure 1). Therefore, the endpoint for the brown trout study is conservative, but is representative of the toxicity to several fish species. It should be noted that acute LOCs are exceeded for 100% of the fish species included in the distribution based on EECs for captan use with the highest application rate, almond (RQs = 0.06 – 0.823).

Captan Fish Data Species Sensitivity Distribution

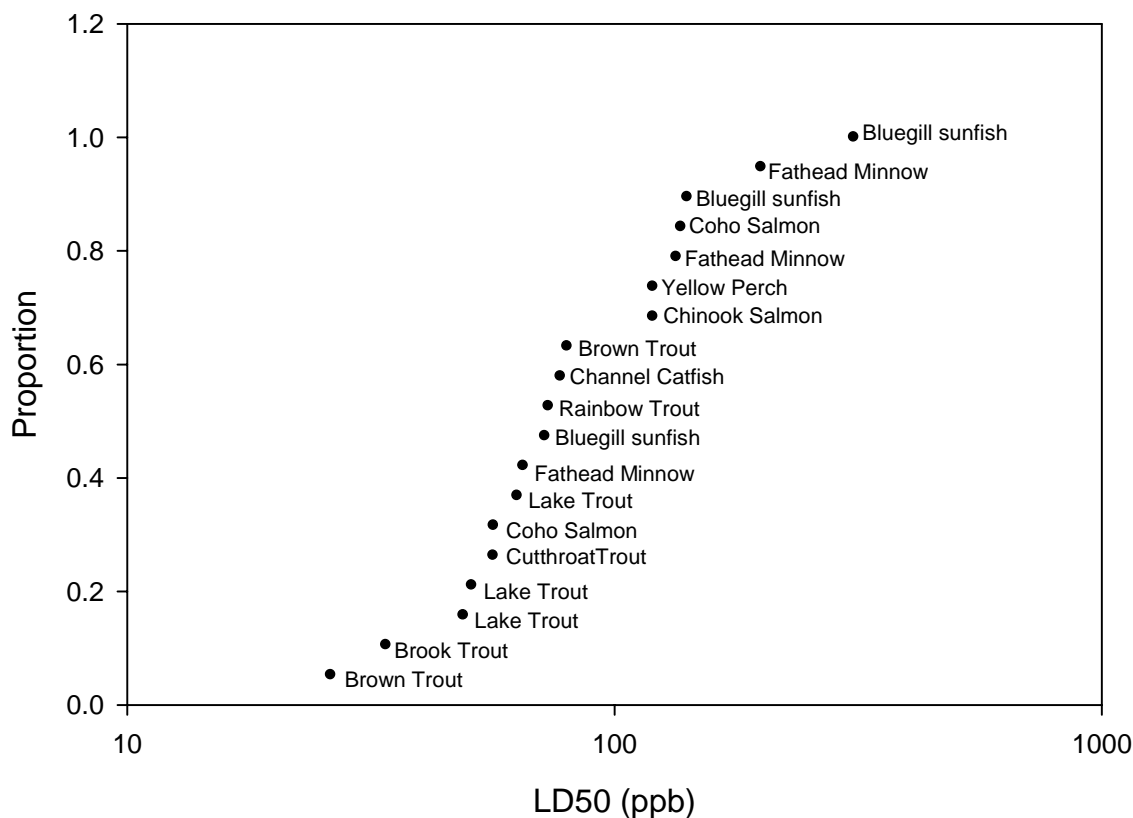


Figure 15. Fish Species Sensitivity Distribution for Captan

Due to lack of partial mortalities the probit slope could not be determined for the brown trout toxicity study used as a surrogate for the aquatic-phase CRLF, information is unavailable to estimate a slope for the dose response curve. Therefore, the probability of an individual effect to aquatic-phase CRLFs was calculated based on a default assumption of 4.5 (with lower and upper bounds of 2 and 9) (Urban and Cook, 1986). The corresponding estimated chance of an individual acute mortality to the aquatic-phase CRLF at an RQ level of 0.823 for almonds is 1 in 2.8 (with respective upper and lower bounds of 1 in 2.3 to 1 in 4.5). The corresponding estimated chance of an individual acute mortality to the aquatic-phase CRLF at an RQ level of 1.09 for almonds is 1 in 1.8 (with respective upper and lower bounds of 1 in 9 to 1 in 6). There is a high probability of an individual mortality occurrence; therefore, captan is likely to adversely affect aquatic-phase CRLFs.

One incident has been reported involving fish kills in which it was highly probable that captan was the cause. In New York in 1972, the spillage of a large spray rig filled with thiodan and captan resulted in the death of 10,000 fish. This incident indicates that direct application of captan to water bodies is highly toxic to fish, which is used as a surrogate for the aquatic-phase CRLF. However, this incident was the result of use that is not in accordance with the current label restrictions for direct applications to water bodies. In summary, the Agency concludes a “likely to adversely affect” determination for direct effects to the aquatic-phase CRLF, via acute affects, *i.e.* mortality, based on all available lines of evidence.

5.2.1.2 Terrestrial-Phase CRLF

Based on acute avian toxicity data as a surrogate for the terrestrial-phase amphibians, direct acute mortality is unknown for the terrestrial-phase CRLF via exposure to captan applications. The avian acute and chronic effects data show no mortality at the highest treatment levels of captan however the test levels are well below estimated exposure in the field. Effects to birds, and therefore terrestrial-phase CRLF, are unknown at such increased exposure levels.

Dose-based Risk

Definitive acute dose-based RQ values for terrestrial-phase CRLFs could not be derived because the acute avian effects data show no mortality to the mallard duck ($LD_{50} > 2,000$ mg/kg bw) and the Northern bobwhite quail duck ($LD_{50} > 2,150$ mg/kg bw). Although definitive dose-based RQs cannot be determined, upper bound RQs were estimated. The predicted acute dose-based EECs (2655 – 4033 ppm based on use on peach) are about four times the adjusted LD_{50} values for juvenile terrestrial-phase CRLFs (1038 mg/kg-bw).

The T-HERPS model was used to better evaluate potential acute dose-based risk. T-HERPS is a modification of T-REX which includes amphibian/reptile specific allometric equations, weight classes appropriate for the CLRF, and prey items specific to the CLRF. The refined dose-based RQs do not exceed the endangered species acute risk LOCs for

all of the frog weight classes consuming insects. Acute dose-based LOCs are exceeded for direct effects for large frogs (238 grams) consuming small herbivorous mammals based on captan use on peaches (upper bound). At this time there is no refinement for dietary and chronic risk to herptiles.

Dietary-based Risk

No mortality was observed at the highest test concentration the acute dietary-based toxicity testing for the mallard duck, Japanese quail, and ring-necked pheasant ($LC_{50} > 5,000$ mg/kg diet) and Northern bobwhite quail ($LC_{50} > 2,400$ mg/kg bw). However, the predicted acute dietary-based EECs (2331 – 3542 ppm) exceed the 2400 mg/kg diet test levels for the quail. The EECs do not exceed the LC_{50} value for the mallard duck, Japanese quail, and ring-necked pheasant ($LC_{50} > 5,000$ mg/kg diet). Therefore, acute dietary-based risk is uncertain for some species of birds at estimated field concentrations.

The mallard duck and bobwhite quail reproduction studies indicate that exposure at the three test concentrations of 100, 300, and 1000 mg/kg diet did not affect reproduction (NOAEC > 1000 mg/kg diet). The predicted dietary-based EECs (2331 – 3542 ppm) also exceed these test levels by up to three times.

Because the upper bound acute and chronic dietary-based LOCs are exceeded for the frogs using the upper bound estimate, there is uncertainty about the level of effects at estimated field concentrations. Therefore, the effects determination for direct acute effects to the terrestrial-phase CRLF via ingestion of terrestrial invertebrate food items is “likely to adversely affect”.

5.2.2 Indirect Effects (via Reductions in Prey Base)

5.2.2.1 Algae (non-vascular plants)

As discussed in Section 2.5.3, the diet of CRLF tadpoles is composed primarily of unicellular aquatic plants (i.e., algae and diatoms) and detritus. Acute risk LOC ($RQ \geq 1.0$) were not exceeded for algae for all of the captan uses (**Table 5.02**). There is uncertainty associated with the nonvascular aquatic plant RQs because they are based on nominal concentrations from the green algae, *Scenedesmus subspicatus* toxicity study ($EC_{50} = 320$ µg/L; ACC 252586). However, this study provides a conservative estimated of the toxicity to algae compared to the other nonvascular aquatic plant studies. In a *Selenastrum capricornutum* (green algae) toxicity study, the $EC_{50} = 1770$ µg/L (MRID 43869809). In an *Anabaena flos-aquae* (freshwater algae) toxicity study, the $EC_{50} = 1200$ µg/L (MRID 44806501). The effects determination is “no effect”, for indirect effects to aquatic-phase CRLFs based on a reduction in non-vascular aquatic plants as food items.

5.2.2.2 Aquatic Invertebrates

Indirect acute effects to the aquatic-phase CRLF via effects to prey (invertebrates) in aquatic habitats are based on peak EECs in the standard pond and the lowest acute

toxicity value for freshwater invertebrates. Acute and chronic risk LOCs were not exceeded for all captan uses (**Table 5.03**). RQs are based on acute and chronic toxicity endpoints of $EC_{50} = 8400 \mu\text{g/L}$ and $NOAEC = 560 \mu\text{g/L}$, respectively. There are uncertainties associated with the results of the chronic study because the test material was reported as being unstable in the water therefore the test concentration in the exposure solutions were not measured during the test. The endpoints are based on nominal concentrations. However, it was determined that there is no potential for chronic risk given that the chronic RQs were three orders of magnitude less than the LOC. The effects determination is “no effect” for indirect effects to aquatic-phase CRLFs based on a reduction of freshwater invertebrates as prey (via direct acute toxicity to freshwater invertebrates) for all modeled uses.

5.2.2.3 Fish and Aquatic-phase Frogs

Fish and aquatic-phase frogs also represent prey of the adult CRLF. RQs associated with acute and chronic direct toxicity to the CRLF (**Table 5.01**) are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items. Given that acute RQs for direct toxicity to the CRLF exceed non-listed acute risk LOCs for freshwater fish, the effects determination is “likely to adversely affect”, based on indirect effects as a reduction of fish and frogs as prey items for foliar application of captan to food and ornamental/turf uses.

5.2.2.4 Terrestrial Invertebrates

When the terrestrial-phase CRLF reaches juvenile and adult stages, its diet is mainly composed of terrestrial invertebrates. In order to assess the risks of foliar applications of captan to terrestrial invertebrates, the bee is used as a surrogate. The most sensitive terrestrial invertebrate study in the open literature was an acute toxicity test using *Osmia ligaria* bees, the 72-hour results for acute contact endpoint was $LD_{50} = 270 \mu\text{g a.i./bee}$ (Ladurner et. al, 2005, ECOTOX ref # 87252). The endpoints are similar in the registrant submitted study in which captan is categorized as practically non-toxic ($LD_{50} > 215 \mu\text{g/bee}$ and $LD_{50} > 10 \mu\text{g/bee}$) to *Apis mellifera* on an acute contact toxicity basis. The RQ values based on the *Osmia* study exceed the LOCs ($RQ \geq 0.05$) for both large and small terrestrial invertebrates for all uses with RQs ranging from 0.03 – 2.07 (**Table 5.07**). Due to lack of raw data, the probit slope could not be determined for the orchard bee toxicity study, and therefore information is unavailable to estimate a slope for the dose response curve. Therefore, the probability of an individual effect to terrestrial invertebrates was calculated based on a default assumption of 4.5 (with lower and upper bounds of 2 and 9) (Urban and Cook, 1986). The corresponding estimated chance of an individual acute mortality to the terrestrial insects at an RQ level of 2.07 for ornamental grasses is 1 in 1.08 (with respective upper and lower bounds of 1 in 1.36 to 1 in 1). There is a high probability of an individual mortality occurrence; therefore, captan is likely to cause direct adverse effects to terrestrial invertebrates. The effects determination for indirect effects to terrestrial-phase CRLFs via reduction in terrestrial invertebrates as dietary food items is “likely to adversely affect”.

Three incidents involving bee kills were reported in Hendersonville, NC in locations where captan was used. However, the reported certainty indexes for the bee incidents were categorized as “unlikely”, because captan was not found in the bees.

5.2.2.5 Mammals

Life history data for terrestrial-phase CRLFs indicate that large adult frogs consume terrestrial vertebrates, including mice. Captan is practically non-toxic for oral acute toxicity to mammals (LD_{50} = 9,000 mg/kg/diet, MRID 00054789, 1949); however, acute dose-based, acute dietary-based and chronic dietary based RQs representing exposures of captan to mice (small mammals) exceeded acute and chronic LOCs or all foliar applications to crops (**Table 5.07**). Acute RQs range from 0.04 to 0.37. Chronic dose-based RQs range from 32.27 – 269. Chronic dietary based RQs range from 3.72 – 31.02. Acute LOCs were not exceeded for captan applied as a seed treatment, however chronic LOCs were exceeded. Due to lack of raw data, the probit slope could not be determined for the acute mammalian toxicity study, and therefore information is unavailable to estimate a slope for the dose response curve. Therefore, the probability of an individual effect to mammals was calculated based on a default assumption of 4.5 (with lower and upper bounds of 2 and 9) (Urban and Cook, 1986). The corresponding estimated chance of an individual acute mortality to the mammals at an RQ level of 0.37 for ornamental grasses is 1 in 38.5 (with respective upper and lower bounds of 1 in 5.16 to 1 in 19,600). There is a high probability of an individual mortality occurrence; therefore, captan is likely to cause direct adverse effects to small mammals. The effects determination for indirect effects to terrestrial-phase CRLFs via reduction in small mammals as dietary food items is “likely to adversely affect”.

The terrestrial action area was based on chronic effects to mammals because the RQ to LOC ratio was the highest for this taxa (Section 5.1.4.2). The resulting terrestrial action area buffer is 1001 ft for the maximum single application rate (almond). Therefore, the terrestrial portion of the captan action area for this assessment includes all potential orchard/vineyard, agricultural and turf use sites and all areas that are within 1001 ft of potential captan use sites in CA.

The chronic mammalian RQ is based on the three-generation reproduction toxicity endpoint (NOAEL = 250 mg a.i./kg diet) for the laboratory rat. Results of the study showed decreases in the mean litter weights of pups and severe sexual organ atrophy in adults and pups. Additionally, there were also signs of severe changes in liver weights in the adult males as well as abdominal and intestinal atrophy. In females, there were signs of stomach atrophy and esophageal atrophy. The reproductive effects are likely to reduce the mammalian prey base of the CRLF.

5.2.2.6 Terrestrial-phase Amphibians

Terrestrial-phase adult CRLFs also consume frogs. RQ values representing direct exposures of captan to terrestrial-phase CRLFs are used to represent exposures of captan

to frogs in terrestrial habitats. Based on estimated exposures resulting from captan use, acute and chronic risks to frogs are possible. Therefore, the effects determination for indirect effects to large CRLF adults that feed on other species of frogs as prey, via chronic exposure to captan, is “likely to adversely affect”.

5.2.3 Indirect Effects (via Habitat Effects)

5.2.3.1 Aquatic Plants (Vascular and Non-vascular)

Aquatic plants serve several important functions in aquatic ecosystems. Non-vascular aquatic plants are primary producers and provide the autochthonous energy base for aquatic ecosystems. Vascular plants provide structure, rather than energy, to the system, as attachment sites for many aquatic invertebrates, and refugia for juvenile organisms, such as fish and frogs. Emergent plants help reduce sediment loading and provide stability to nearshore areas and lower streambanks. In addition, vascular aquatic plants are important as attachment sites for egg masses of CRLFs.

Potential indirect effects to the CRLF based on impacts to habitat and/or primary production were assessed using RQs from freshwater aquatic vascular and non-vascular plant data. RQs for non-vascular and vascular plants do not exceed LOCs for all captan uses. The effects determination for indirect effects of captan to CRLFs via impacts to habitat and/or primary production through direct effects to aquatic plants is “no effect”.

5.2.3.2 Terrestrial Plants

Terrestrial plants serve several important habitat-related functions for the CRLF. In addition to providing habitat and cover for invertebrate and vertebrate prey items of the CRLF, terrestrial vegetation also provides shelter for the CRLF and cover from predators while foraging. Upland vegetation including grassland and woodlands provides cover during dispersal. Riparian vegetation helps to maintain the integrity of aquatic systems by providing bank and thermal stability, serving as a buffer to filter out sediment, nutrients, and contaminants before they reach the watershed, and serving as an energy source. Loss, destruction, and alteration of habitat were identified as a threat to the CRLF in the USFWS Recovery Plan (USFWS, 2002).

Captan is a non-systemic, phthalimide fungicide used to control fungal diseases of many fruit, ornamental, and vegetable crops and is not expected to be lethal to terrestrial plants. The mode of action of captan is inhibition of normal cell division of a broad spectrum of microorganisms and fungi. Captan is known as a stressor to aquatic organisms and to lesser degree mammals by limiting and ultimately inhibiting the process of *oxidative phosphorylation*, which is needed for respiration in aquatic organisms as well as terrestrial organisms and humans. However, effects are expected to be limited in plants. Potential indirect effects to the CRLF resulting from direct effects on riparian and upland vegetation are typically assessed using RQs from terrestrial plant seedling emergence and vegetative vigor EC₂₅ data as a screen. Because the Agency waived submission of terrestrial plant toxicity studies for captan, there are no guideline terrestrial plant toxicity

studies submitted for the exposure to captan to terrestrial vascular and non-vascular plants (U.S. EPA, 1999).

Using studies obtained from ECOTOX, it was not possible to determine endpoints analogous to the seedling emergence or vegetative vigor EC₂₅. Therefore, no RQ calculation was performed.

Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Individual seed exposure to captan was high as seeds were coated with captan by shaking seeds and pesticide in a closed container. This exposure is likely to be higher than expected exposure due to spray drift and runoff after application in the field. None of these papers reported any negative effects of captan on germination or growth of seedlings. The results of these studies were considered qualitatively in lieu of a seedling emergence study.

Based on ECOTOX data, there is the potential that terrestrial plants may be impacted by foliar application of captan. In one study (#63909), highbush blueberries showed mild phytotoxic effects at an application rate of 2.5 lbs ai/acre (foliar application rates for captan range from 2.0 to 4.5 lbs ai/acre). It is unknown where highbush blueberries fall in the species sensitivity distribution for dicots or for terrestrial plants in general. The results of this test indicate that a variety of terrestrial plants that may inhabit riparian and upland zones may be sensitive to captan exposure. However, calculated EECs are much less than the exposure causing mild phytotoxic effects to blueberries in the study.

Further, captan has a history of being applied to a myriad of agricultural and non-agricultural crops (as per the label), with only two incidents of ‘possible’ damage to terrestrial plants. Both instances were misuse of captan and several other pesticides (1) formulator of seed treatment combined incorrect pesticides and (2) grower did not rinse tank thoroughly between pesticide applications and applied a pesticide not registered for apples on apples (the damaged crop). As a foliar spray, captan may be routinely applied multiple times per growing season. Labeled use has not resulted in any reported incidents.

Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. The effects determination for indirect effects to terrestrial- and aquatic-phase CRLFs via reduction in the terrestrial plant community is “may affect, not likely to adversely affect” (NLAA) due to insignificant effects.

5.2.4 Modification to Designated Critical Habitat

5.2.4.1 Aquatic-Phase PCEs

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

The effects determinations for indirect effects to the CRLF via direct effects to aquatic and terrestrial plants are used to determine whether modification to critical habitat may occur. Based on the results of the effects determinations for aquatic plants (see Sections 5.2.2.1 and 5.2.3.1), there is no modification of critical habitat of the CRLF via captan-related impacts to non-vascular and vascular aquatic plants as food items for tadpoles and habitat for aquatic-phase CRLFs.

Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. The effects determination for indirect effects to terrestrial- and aquatic-phase CRLFs via reduction in the terrestrial plant community is “may affect, not likely to adversely affect” (NLAA) due to insignificant effects.

The remaining aquatic-phase PCE is “alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.” Other than impacts to algae as food items for tadpoles (discussed above), this PCE was assessed by considering direct and indirect effects to the aquatic-phase CRLF via acute and chronic freshwater fish and invertebrate toxicity endpoints as measures of effects. As discussed in Section 5.2.1.1, direct acute effects to the aquatic-phase CRLF and/or freshwater fish as food items are expected. However, captan-related effects to freshwater invertebrates as food items are not likely to occur (5.2.2.3). Therefore, captan may result in modification to critical habitat by altering chemical characteristics necessary for normal growth and viability of aquatic-phase CRLFs and their non-plant food sources.

5.2.4.2 Terrestrial-Phase PCEs

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance.
- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of

each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.

As discussed above, due to multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants (see Section 5.2.3.2). The effects determination for indirect effects to terrestrial- and aquatic-phase CRLFs via reduction in the terrestrial plant community is “may affect, not likely to adversely affect” (NLAA) due to insignificant effects.

The third terrestrial-phase PCE is “reduction and/or modification of food sources for terrestrial phase juveniles and adults.” To assess the impact of captan on this PCE, acute and chronic toxicity endpoints for terrestrial invertebrates, mammals, and terrestrial-phase frogs are used as measures of effects. Based on the characterization of indirect effects to terrestrial-phase CRLFs via reduction in the prey base (see Section 5.2.2.4 for terrestrial invertebrates, Section 5.2.2.5 for mammals, and 5.2.2.6 for frogs), critical habitat may be modified via a reduction in mammals and terrestrial-phase amphibians as food items.

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. As discussed in Section 5.2.1.2, direct acute effects, via mortality, are expected for the terrestrial-phase CRLF. Therefore, captan may result in modification of critical habitat by altering chemical characteristics necessary for normal growth and viability of terrestrial-phase CRLFs and their mammalian and amphibian food sources.

6. Uncertainties

6.1 Exposure Assessment Uncertainties

6.1.1 Maximum Use Scenario

The screening-level risk assessment focuses on characterizing potential ecological risks resulting from a maximum use scenario, which is determined from labeled statements of maximum application rate and number of applications with the shortest time interval between applications. The frequency at which actual uses approach this maximum use scenario may be dependant on insecticide resistance, timing of applications, cultural practices, and market forces.

6.1.2 Aquatic Exposure Modeling of Captan

The standard ecological water body scenario (EXAMS pond) used to calculate potential aquatic exposure to pesticides is intended to represent conservative estimates, and to avoid underestimations of the actual exposure. The standard scenario consists of application to a 10-hectare field bordering a 1-hectare, 2-meter deep (20,000 m³) pond with no outlet. Exposure estimates generated using the EXAMS pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds

including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and lower order streams. As a group, there are factors that make these water bodies more or less vulnerable than the EXAMS pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the EXAMS pond. These water bodies will be either smaller in size or have larger drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the EXAMS pond has no discharge. As watershed size increases beyond 10-hectares, it becomes increasingly unlikely that the entire watershed is planted with a single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the EXAMS pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

The Agency acknowledges that there are some unique aquatic habitats that are not accurately captured by this modeling scenario and modeling results may, therefore, under- or over-estimate exposure, depending on a number of variables. For example, aquatic-phase CRLFs may inhabit water bodies of different size and depth and/or are located adjacent to larger or smaller drainage areas than the EXAMS pond. The Agency does not currently have sufficient information regarding the hydrology of these aquatic habitats to develop a specific alternate scenario for the CRLF. CRLFs prefer habitat with perennial (present year-round) or near-perennial water and do not frequently inhabit vernal (temporary) pools because conditions in these habitats are generally not suitable (Hayes and Jennings 1988). Therefore, the EXAMS pond is assumed to be representative of exposure to aquatic-phase CRLFs. In addition, the Services agree that the existing EXAMS pond represents the best currently available approach for estimating aquatic exposure to pesticides (USFWS/NMFS 2004).

In general, the linked PRZM/EXAMS model produces estimated aquatic concentrations that are expected to be exceeded once within a ten-year period. The Pesticide Root Zone Model is a process or “simulation” model that calculates what happens to a pesticide in a farmer’s field on a day-to-day basis. It considers factors such as rainfall and plant transpiration of water, as well as how and when the pesticide is applied. It has two major components: hydrology and chemical transport. Water movement is simulated by the use of generalized soil parameters, including field capacity, wilting point, and saturation water content. The chemical transport component can simulate pesticide application on the soil or on the plant foliage. Dissolved, adsorbed, and vapor-phase concentrations in the soil are estimated by simultaneously considering the processes of pesticide uptake by plants, surface runoff, erosion, decay, volatilization, foliar wash-off, advection, dispersion, and retardation.

Uncertainties associated with each of these individual components add to the overall uncertainty of the modeled concentrations. Additionally, model inputs from the environmental fate degradation studies are chosen to represent the upper confidence bound on the mean values that are not expected to be exceeded in the environment approximately 90 percent of the time. Mobility input values are chosen to be representative of conditions in the environment. The natural variation in soils adds to the

uncertainty of modeled values. Factors such as application date, crop emergence date, and canopy cover can also affect estimated concentrations, adding to the uncertainty of modeled values. Factors within the ambient environment such as soil temperatures, sunlight intensity, antecedent soil moisture, and surface water temperatures can cause actual aquatic concentrations to differ for the modeled values.

Unlike spray drift, tools are currently not available to evaluate the effectiveness of a vegetative setback on runoff and loadings. The effectiveness of vegetative setbacks is highly dependent on the condition of the vegetative strip. For example, a well-established, healthy vegetative setback can be a very effective means of reducing runoff and erosion from agricultural fields. Alternatively, a setback of poor vegetative quality or a setback that is channelized can be ineffective at reducing loadings. Until such time as a quantitative method to estimate the effect of vegetative setbacks on various conditions on pesticide loadings becomes available, the aquatic exposure predictions are likely to overestimate exposure where healthy vegetative setbacks exist and underestimate exposure where poorly developed, channelized, or bare setbacks exist.

In order to account for uncertainties associated with modeling, available monitoring data were compared to PRZM/EXAMS estimates of peak EECs for the different uses. As discussed above, data were not available from NAWQA for captan. Captan was not found at detectable levels as reported by the California Department of Pesticide Regulation surface water database (2000-2005). The use of the PRZM/EXAMS EECs is assumed to represent a conservative measure of exposure.

6.1.3 Action Area

An example of an important simplifying assumption that may require future refinement is the assumption of uniform runoff characteristics throughout a landscape. It is well documented that runoff characteristics are highly non-uniform and anisotropic, and become increasingly so as the area under consideration becomes larger. The assumption made for estimating the aquatic action area (based on predicted in-stream dilution) was that the entire landscape exhibited runoff properties identical to those commonly found in agricultural lands in this region. However, considering the vastly different runoff characteristics of: a) undeveloped (especially forested) areas, which exhibit the least amount of surface runoff but the greatest amount of groundwater recharge; b) suburban/residential areas, which are dominated by the relationship between impermeable surfaces (roads, lots) and grassed/other areas (lawns) plus local drainage management; c) urban areas, that are dominated by managed storm drainage and impermeable surfaces; and d) agricultural areas dominated by Hortonian and focused runoff (especially with row crops), a refined assessment should incorporate these differences for modeled stream flow generation. As the zone around the immediate (application) target area expands, there will be greater variability in the landscape; in the context of a risk assessment, the runoff potential that is assumed for the expanding area will be a crucial variable (since dilution at the outflow point is determined by the size of the expanding area). Thus, it is important to know at least some approximate estimate of types of land use within that region. Runoff from forested areas ranges from 45 –

2,700% less than from agricultural areas; in most studies, runoff was 2.5 to 7 times higher in agricultural areas (e.g., Okisaka et al., 1997; Karvonen et al., 1999; McDonald et al., 2002; Phuong and van Dam 2002). Differences in runoff potential between urban/suburban areas and agricultural areas are generally less than between agricultural and forested areas. In terms of likely runoff potential (other variables – such as topography and rainfall – being equal), the relationship is generally as follows (going from lowest to highest runoff potential):

Three-tiered forest < agroforestry < suburban < row-crop agriculture < urban.

There are, however, other uncertainties that should serve to counteract the effects of the aforementioned issue. For example, the dilution model considers that 100% of the agricultural area has the chemical applied, which is almost certainly a gross over-estimation. Thus, there will be assumed chemical contributions from agricultural areas that will actually be contributing only runoff water (dilutant); so some contributions to total contaminant load will really serve to lessen rather than increase aquatic concentrations. In light of these (and other) confounding factors, Agency believes that this model gives us the best available estimates under current circumstances.

6.1.4 Usage Uncertainties

County-level usage data were obtained from California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. Four years of data (2002 – 2005) were included in this analysis because statistical methodology for identifying outliers, in terms of area treated and pounds applied, was provided by CDPR for these years only. No methodology for removing outliers was provided by CDPR for 2001 and earlier pesticide data; therefore, this information was not included in the analysis because it may misrepresent actual usage patterns. CDPR PUR documentation indicates that errors in the data may include the following: a misplaced decimal; incorrect measures, area treated, or units; and reports of diluted pesticide concentrations. In addition, it is possible that the data may contain reports for pesticide uses that have been cancelled. The CPDR PUR data does not include home owner applied pesticides; therefore, residential uses are not likely to be reported. As with all pesticide use data, there may be instances of misuse and misreporting. The Agency made use of the most current, verifiable information; in cases where there were discrepancies, the most conservative information was used.

6.1.5 Terrestrial Exposure Modeling of Captan

The Agency relies on the work of Fletcher et al. (1994) for setting the assumed pesticide residues in wildlife dietary items. These residue assumptions are believed to reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify. It is important to note that the field measurement efforts used to develop the Fletcher estimates of exposure involve highly varied sampling techniques. It is entirely possible that much of these data reflect

residues averaged over entire above ground plants in the case of grass and forage sampling.

It was assumed that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy differences. Direct comparison of a laboratory dietary concentration- based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 – 2.5 for most food items.

Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 – 80%, and mammal's assimilation ranges from 41 – 85% (U.S. Environmental Protection Agency, 1993). If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (e.g., a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

For this terrestrial risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

6.2 Effects Assessment Uncertainties

6.2.1 Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies, mayflies, and third instar for midges).

Testing of juveniles may overestimate toxicity at older age classes for pesticide active ingredients that act directly without metabolic transformation because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, this assessment uses the most sensitive life-stage information as measures of effect for surrogate aquatic animals, and is therefore, considered as protective of the CRLF.

6.2.2 Use of surrogate species effects data

Currently, there are no FIFRA guideline toxicity tests for amphibians. Therefore, in accordance with the Overview Document (U.S. EPA 2004), data for the most sensitive freshwater fish are used as a surrogate for aquatic-phase amphibians such as the California red-legged frog. Available open literature information on captan toxicity to aquatic-phase amphibians (larvae of *Xenopus laevis*, African clawed frog, and *Pleurodeles waltl*, Spanish ribbed newt; ECOTOX# 90515) shows these non-native species are approximately 4 to 6 times less sensitive than the freshwater fish endpoint EFED used in the assessment. Therefore, the endpoint based on freshwater fish ecotoxicity data is assumed to be protective. Extrapolation of the risk conclusions from the most sensitive tested species to the California red-legged frog is more likely to overestimate the potential risks than to underestimate the potential risk. Information to indicate where the California red-legged frog may fall in a species sensitivity distribution was not located.

6.2.3 Sublethal Effects

For an acute risk assessment, the screening risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide, as determined by the testing of species response to chronic exposure conditions and subsequent chronic risk assessment. Consideration of additional sublethal data in the assessment is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints.

Open literature is useful in identifying sublethal effects associated with exposure to captan. These effects in freshwater fish include, but are not limited to, decreased response from olfactory epithelium and effects on endocrine-mediated processes. However, no data are available to link the sublethal measurement endpoints to direct mortality or diminished reproduction, growth and survival that are used by OPP as assessment endpoints. While the study by Moore and Lower (2001) attempted to relate the results of olfactory perfusion assays to decreased predator avoidance and homing response in salmon, there are a number of uncertainties associated with the study that limit its utility. OPP acknowledges that sublethal effects have been associated with captan exposure; however, at this point there are insufficient data to definitively link the measurement endpoints to assessment endpoints. To the extent to which sublethal effects are not considered in this assessment, the potential direct and indirect effects of captan on CRLF may be underestimated.

7. Risk Conclusions

In fulfilling its obligations under Section 7(a)(2) of the Endangered Species Act, the information presented in this endangered species risk assessment represents the best data currently available to assess the potential risks of captan to the CRLF and its designated critical habitat. The best available data suggest that captan may affect and is likely to adversely affect the CRLF, based on direct acute effects to aquatic-phase CRLF and acute and chronic terrestrial-phase CRLF. In addition, captan may affect and is likely to adversely affect the CRLF, based on indirect effects to both aquatic- and terrestrial phase CRLFs (via reduction in terrestrial invertebrates, mammals, fish and frogs as food). In addition, these effects also constitute modification to critical habitat via alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. These effects are anticipated to occur only for those occupied core habitat areas, CNDBB occurrence sections, and designated critical habitat for the CRLF that are located ≤ 1001 feet from legal use sites where captan is applied aerially.

A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat, given the uncertainties discussed in Section 6, is presented in Tables 7.1 and 7.2.

Table 7.0 1. Effects Determination Summary for Captan - Direct and Indirect Effects to CRLF		
Assessment Endpoint	Effects Determination	Basis For Preliminary Determination
<i>Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)</i>		
<u>Direct Effects</u> Survival, growth, and reproduction of CRLF individuals	LAA	Using freshwater fish as a surrogate, non-listed acute risk LOCs are exceeded, chronic LOCs are not exceeded (Table 5.01).
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects to food supply (<i>i.e.</i> , freshwater invertebrates, non-vascular plants, fish and frogs)	Aquatic invertebrates and non-vascular plants: No Effect	Acute freshwater invertebrate RQs do not exceed acute or chronic LOCs (Tables 5.03). Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02).
	Fish and Frogs: LAA	Non-listed acute risk LOCs are exceeded based on the most sensitive toxicity data for freshwater fish (Table 5.01).
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on habitat, cover, and/or primary productivity (<i>i.e.</i> , aquatic plant community)	No Effect	Aquatic non-vascular plant (Table 5.02) and vascular plant (Table 5.04) RQs do not exceed acute LOCs for all captan uses.
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.
<i>Terrestrial Phase (Juveniles and adults)</i>		
<u>Direct Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on terrestrial phase adults and juveniles	LAA	Although no mortality was observed at the highest test concentrations in the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels and upper-bound RQ values exceed avian non-listed acute risk and chronic LOCs for all uses (Table 5.05).
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on prey (<i>i.e.</i> , terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	LAA	Non-listed acute risk and chronic LOCs are exceeded for mammals and birds. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05, 5.06, and 5.07). Non-listed acute risk LOCs are exceeded based on the most sensitive toxicity data for freshwater fish (Table 5.01) which are a surrogate for terrestrial phase amphibians.
<u>Indirect Effects</u> Survival, growth, and reproduction of CRLF individuals via effects on habitat (<i>i.e.</i> , riparian vegetation)	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.

Table 7.02. Effects Determination Summary for Captan – PCEs of Designated Critical Habitat for the CRLF		
Assessment Endpoint	Effects Determination	Basis For Preliminary Determination
<i>Aquatic Phase PCEs</i> <i>(Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)</i>		
<u>Indirect Effects</u> Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.
<u>Indirect Effects</u> Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	NLAA (insignificant)	
<u>Indirect Effects</u> Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	<u>Growth and viability of CRLF:</u> Modification	Using freshwater fish as a surrogate, non-listed acute risk LOCs are exceeded for all uses (Table 5.01).
	<u>Food source:</u> No Effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02). Aquatic vascular plant LOCs are not exceeded for applications of captan to all uses (Table 5.04).
<u>Indirect Effects</u> Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	No Effect	Aquatic non-vascular plant RQs do not exceed acute LOCs (Tables 5.02).
<i>Terrestrial Phase PCEs</i> <i>(Upland Habitat and Dispersal Habitat)</i>		
<u>Indirect Effects</u> Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	NLAA (insignificant)	Multiple lines of evidence suggest that captan poses minimal risk to terrestrial plants. Based on open literature data identified by ECOTOX, captan as a seed treatment did not negatively impact germination or growth of the evaluated plant species. Mild phytotoxic effects were observed in highbush blueberries at an application rate of 2.5 lbs ai/acre; this application rate is much greater than the off-field EECs based on TERRPLANT calculations.
<u>Indirect Effects</u> Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	NLAA (insignificant)	

Table 7.02. Effects Determination Summary for Captan – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Effects Determination	Basis For Preliminary Determination
<u>Indirect Effects</u> Reduction and/or modification of food sources for terrestrial phase juveniles and adults	Modification	Non-listed acute and chronic LOCs are exceeded for mammals and birds for all modeled uses of captan. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05 – 5.09).
<u>Indirect Effects</u> Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Modification	Non-listed acute and chronic LOCs are exceeded for mammals and birds for all modeled uses of captan. Acute RQs for terrestrial invertebrates also exceed the LOC for all modeled uses of captan (Tables 5.05 – 5.09).

When evaluating the significance of this risk assessment’s direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (i.e., food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (i.e., attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment’s predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.
- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term

prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

8. References

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